The River Glaven

A State of the Environment Report

Produced by Norfolk Biodiversity Information Service

Norfolk Biodiversity Information Service (NBIS) is a Local Record Centre holding information on species, GEODIVERSITY, habitats and protected sites for the county of Norfolk. For more information see our website: www.nbis.org.uk

This report is available for download from the NBIS website www.nbis.org.uk

Report written by Lizzy Oddy, March 2014.

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Cover Photos Clockwise from top left: Wiveton Bridge (©Evelyn Simak and licensed for reuse under this Creative Commons Licence); Glandford Ford (©Ashley Dace and licensed for reuse under this Creative Commons Licence); River Glaven above Glandford (©Oliver Dixon and licensed for reuse under this Creative Commons Licence); Swan at Glandford Ford (© Ashley Dace and licensed for reuse under this Creative Commons Licence).

CONTENTS

FOREWORD

The River Glaven starts its journey from Lower Bodham, gently meandering through some beautiful countryside and picturesque Norfolk villages to meet the sea at Cley sluice.

The river has a catchment area of 115 km^2 and is 17km long from source to sea. It has two major TRIBUTARIES, Stody Beck and Thornage Beck. Lakes and pond also play their part in the diverse wildlife and habitats associated with the river, Hempstead mill pond, Edgefield Hall Lake, Bayfield Hall Lake and Selbrigg Pond being a few worth seeing.

The river is special in that it is a chalk river of which there are only around 200 in the world. It is surrounded by arable land, coniferous plantations, grazing meadows and wetlands.

History has left its mark on the river with 6 surviving watermills - Hempstead, Hunworth, Thornage, Letheringsett, Letheringsett Brewery Mill and Glandford. Letheringsett Mill is still operational and is the only working watermill in Norfolk.

For wildlife enthusiasts the river Glaven is a wonderful spot at which you are guaranteed to see something special. Water voles and otters are regular visitors along with Buzzards, Osprey, Barn Owls and Kingfishers. Sea Trout, White Clawed Crayfish, Eel and Brook Lampreys may be glimpsed in the clear waters. The river is also special for insects and INVERTEBRATES and includes a wide selection of Damselflies, Dragonflies and Hawkers.

The 9 Chalk Rivers project recognises the important part the river plays in the wider area both for wildlife and people. The river has been diverted and modified (straightened) in places. It also suffers from silt build up from roads and adjacent farmland. There are some non native species such as Red Signal Crayfish which threaten our native White Clawed Crayfish population and so habitats need to be improved for species alongside the need for better flood storage solutions to safeguard communities.

This chalk river is doubly rare in that public access alongside is very good. You can get close to the river and see for yourself its beauty and clarity. Perhaps a good starting point for a trip would be Natural Surroundings at Bayfield of which there is a nature reserve and visitor centre with parking, shop and tea room and from here it is a short walk to Glandford Mill.

I hope you enjoy reading this guide for the river and please do see it for yourself. Norfolk is so lucky to be blessed with the presence of these amazing chalk rivers, which truly are gems of the natural world. However they do need our attention if we want to safeguard their future so if you want to get involved with the work of the project then we would love to hear from you.

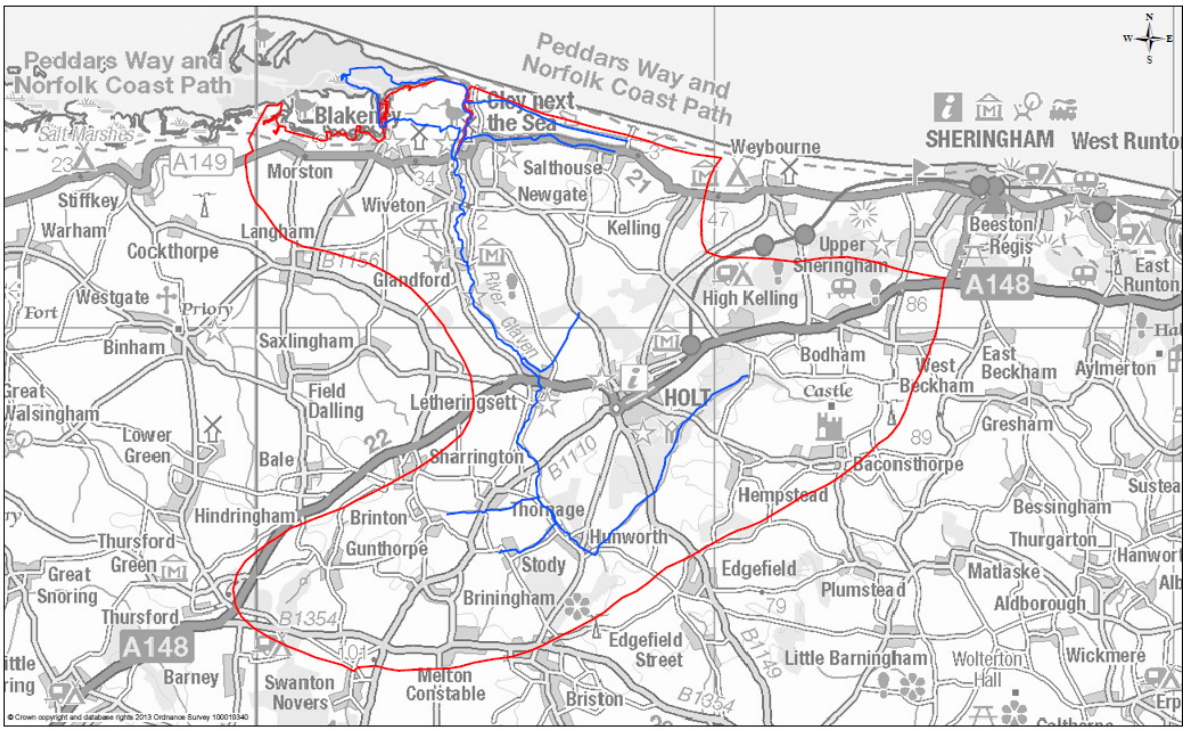
Gemma Clark - 9 Chalk Rivers Project Community Involvement Officer
http://www.norfolkriverstrust.org/

WELCOME

The River Glaven is a North Norfolk chalk river which flows for 17 km from its source near Bodham to where it enters the sea behind Blakeney Point spit. Its catchment covers the area from Morston to Weybourne and south as far as Melton Constable. The boundary of the catchment can be seen on the map below. Partly included in the Norfolk Coast Area of Outstanding Natural Beauty (AONB), the Glaven catchment area has some fantastic scenery, important wildlife and heritage sites, a great variety of habitats and land uses and lots of wildlife.

This report is written by Norfolk Biodiversity Information Service (NBIS) with contributions from people who live and work in the Glaven catchment. It brings together key information about the environment of the Glaven catchment, showcasing the important sites, species, habitats, geology and historic features of the area. It aims to inform, inspire and enthuse local people like you to get out and enjoy the Glaven area. The data included provides a baseline to be compared against in the future to show how the environment of the Glaven catchment is changing.

If, after reading this State of the Environment Report, you want to find out more about particular aspects of the Glaven catchment environment, useful web links are provided on page 42. Definitions of words in SMALL CAPITALS are given in the glossary on page 40.



The red outline on the map above shows the boundary of the River Glaven catchment area. The blue line shows the River Glaven and its TRIBUTARIES.

LANDSCAPE AND GEODIVERSITY

GEODIVERSITY underpins the landscape of the Glaven catchment. Natural processes have been working over many thousands (and millions) of years to produce the landforms and soils of the catchment, and the range of important wildlife habitats we see today.

Chalk Rivers

The Glaven is a chalk river. This is a rare type of spring-fed river. Chalk rivers are a declining habitat. There are only around 200 left worldwide and about 160 of them are in Britain. The sub-surface geology of the Glaven catchment is mainly chalk, and in the lower valley, parts of the river flow over a chalk bed.

Chalk is porous to rainwater, so as rain falls onto chalk it percolates through, emerging lower down the slope in a spring. As the water passes through the chalk it dissolves some of it and transports these chalk minerals downstream. This mineral rich water is great for wildlife! Chalk streams also carry very little suspended sediment, meaning they generally look exceptionally clear. The river bed is usually made up of gravels which is good for INVERTEBRATES.

Sources:
www.norfolkriverstrust.org; www.riverglaven.co.uk/about-the-river-glaven; www.wildlifetrusts.org/wildlife/habitats/chalk-streams

Landscape Features

The landscape in the Glaven catchment is dotted with dozens of gravelly knolls and mounds. There is much debate amongst geologists over the origin of these mounds. Some possibilities are:

- They could be the eroded remains of a once extensive sheet of OUTWASHED GRAVEL that was deposited during the ANGLIAN GLACIATION.
- They could be relict 'KAMES' deposited individually as the glacier retreated.
- They could have developed in a post- ANGLIAN GLACIATION period.
- Or they could have resulted from centuries of agriculture accentuating the relief of the land.

Whatever their origin, these mounds are a charateristic feature of the Glaven catchment landscape.

Source: http://www.norfolkcoastaonb.org.uk/pages/pspage.php?PageID=568

Blakeney Esker

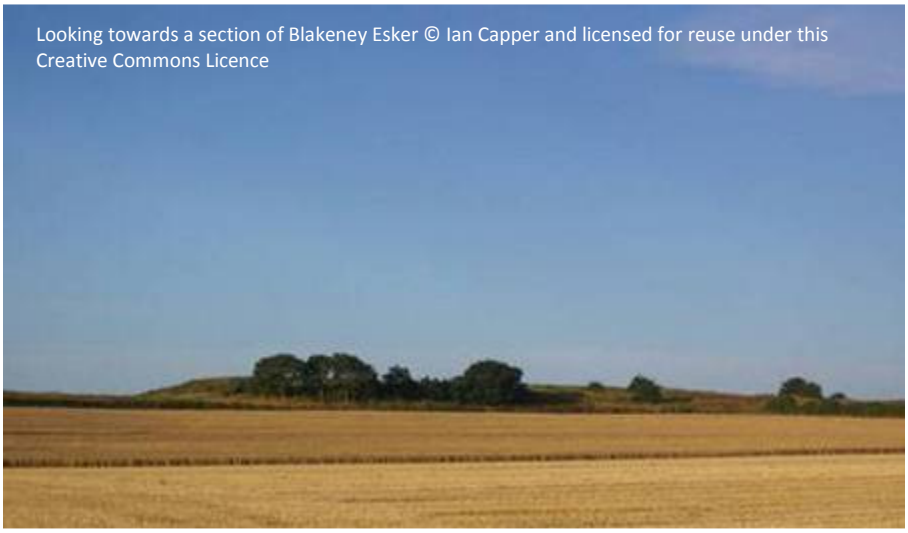
Blakeney Esker is a ridge that runs from Blakeney to Wiveton. It was formed during the time when much of Norfolk was covered with ice. A river of meltwater was flowing beneath the glacier, carrying with it large amounts of sand and gravel. As the water slowed down, it dropped this sand and gravel, and when the glacier retreated, the ridge it had become was left behind.

The esker is now covered in vegetation, and has been altered by past quarrying – it was used as a local source of sand and gravel from World War II until the early 1990s, when all of the useful material had been removed.

The vegetation on the esker is made up of plants that need sandy, acidic, well-drained soils. The soil of the esker is very different to that of the surrounding area, which is generally quite clayey, chalky and poorly drained. This means that the vegetation around the esker is very different too.

At the southern end of Blakeney Esker is Wiveton Downs Local Nature Reserve, which is also designated as a geological Site of Special Scientific Interest.

Source: www.bgs.ac.uk/blakeney



Looking towards a section of Blakeney Esker © Ian Capper and licensed for reuse under this Creative Commons Licence

GEODIVERSITY Sites

These are non-designated sites of GEODIVERSITY interest determined by the Norfolk GEODIVERSITY Partnership. There are **13** GEODIVERSITY sites within the Glaven catchment.

Table 1: Geodiversity sites within the Glaven catchment

Name	Description
Bilsey Hill Pit GCR	Former quarry
Cley Car Park	Old quarry
Edgefield Heath	Heathland
Edgefield Heath Quarry & Edgefield Gravel Pit	Quarry
Furze Hill & Scrib Hill	Hills
Glandford Hurdle Lane GCR	Former sand and gravel pit
Glandford Letheringsett Road GCR	Former sand and gravel pit
Holt Quarry	Active sand and gravel quarry
Letheringsett Marl Pit	Small marl pit
Salthouse Heath	Heathland developed on plateau gravels
Stody Gravel Pit	Small farm gravel pit
Wiveton Downs GCR & Blakeney Esker	Sinuous glacigenic ridge partly quarried away
Wiveton Downs Pit GCR	Former gravel pit used as picnic site

IMPORTANT SITES

Did you know that there are sites within the Glaven catchment that are important for their wildlife or geology at a county, national or even international level? These sites are crucial for the conservation of rare plants, animals and geology, and many of them are open to the public allowing you to explore and experience nature for yourself.

Site Designations

There are a number of designations that a site can be given in the UK, providing different levels of protection. For example, 'statutory sites' are protected by law in the planning process, while 'non-statutory' sites are not, although they are still recognised as important and taken into account in planning. The different levels of designation are summarised below:

Designation		Description
Ramsar Site	Statutory international	An internationally important wetland site, designated under the RAMSAR CONVENTION.
Special Protection Area (SPA)	Statutory international	European designation for sites of international importance for birds.
Special Area of Conservation (SAC)	Statutory international	European protected site designated by the UK government. Sites of international importance under the EC HABITATS DIRECTIVE.
Site of Special Scientific Interest (SSSI)	Statutory national	Designated and protected by Natural England as the best sites for wildlife or geology in the country.
National Nature Reserve (NNR)	Statutory national	A site of national importance for nature conservation. Allow scientific research and most have at least some public access.
Local Nature Reserve (LNR)	Statutory local	A site of special nature conservation interest locally, designated by local authorities.
County Wildlife Site (CWS)	Non-statutory county	Sites outside of statutory protected areas but of wildlife importance at a county level.

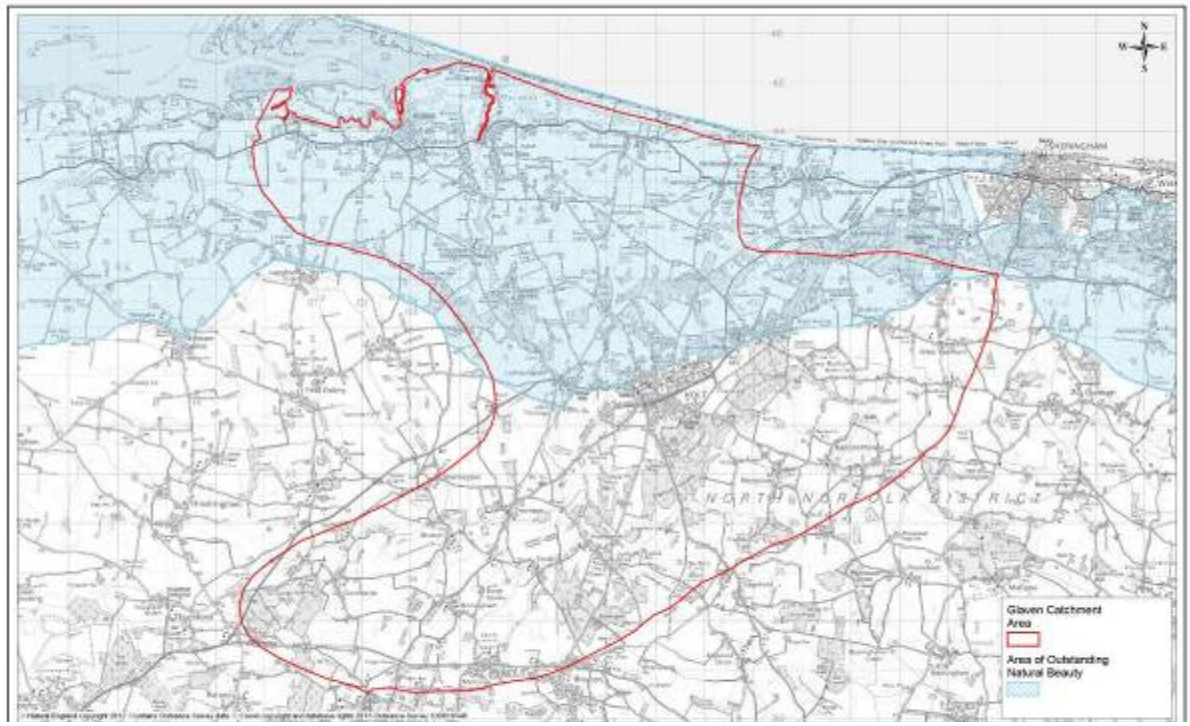
The Norfolk Coast Area of Outstanding Natural Beauty (AONB)

Designated in 1968, the Norfolk Coast AONB stretches from the Wash in the west through to the dune system at Winterton in the east. It is an area of remarkable beauty, diversity and scientific importance.

The AONB contains habitats including sand and mud flats, dunes, shingle, saltmarsh, reedbeds, grazing marsh and soft cliffs. The natural beauty of the area includes its distinctive wildlife and cultural heritage as well as the scenic beauty of the landscape. Its management is facilitated by The Norfolk Coast Partnership.

The Norfolk Coast Partnership has been running since 1991. It aims to "conserve and enhance the natural beauty of the area, to facilitate and enhance public enjoyment, understanding and appreciation of the area and to provide sustainable forms of social and economic development that in themselves conserve and enhance the area's natural beauty."

Source: http://www.norfolkcoastaonb.org.uk/



Map showing where the River Glaven catchment area falls within the Norfolk Coast Area of Outstanding Natural Beauty.

Statutory Sites in the Glaven Catchment

Table 2: Statutory wildlife sites within the Glaven catchment, and their areas.

Site Type	Site Name	Area with Glaven catchment (ha)
Ramsar	North Norfolk Coast	502.8
Special Area of Conservation	North Norfolk Coast	235.9
Special Area of Conservation	Norfolk Valley Fens	49.4
Special Area of Conservation	The Wash & North Norfolk Coast	10.8
Special Protection Area	N Norfolk Coast	502.8
National Nature Reserve	Swanton Novers Wood	4.7
National Nature Reserve	Blakeney	176.5
National Nature Reserve	Holkham	3.1
Local Nature Reserve	Wiveton Down	6.49

North Norfolk Coast. © Pat Lorber

Sites of Special Scientific Interest

There are **eight SSSIs** in the Glaven catchment, covering an area of **621.1 hectares (ha)**. They are Bilsey Hill, Glandford (Hurdle Lane), Glandford (Letheringsett Road), Holt Lowes, Kelling Heath, North Norfolk Coast, Swanton Novers Wood and Wiveton Downs.

Bilsey Hill, **Glandford (Hurdle Lane)**, **Glandford (Letheringsett Road)** and **Wiveton Downs** are all designated for their GEODIVERSITY. The sites are all in close proximity to each other and can be studied together. Wiveton Downs is often known to geologists as Blakeney Esker (see page 3), and is a "classic landform of outstanding importance for teaching, research and demonstration purposes."

Holt Lowes shows an "excellent example of a mixed VALLEY MIRE in a small TRIBUTARY valley that bisects the heath." Several rare plants and animals are found on the site, including some found nowhere else in East Anglia.

Kelling Heath is "perhaps the best example of a GLACIAL OUTWASH PLAIN in England." It is also a "fine example of oceanic heathland". A good number of species of heathland birds nest on the site and the habitat is also good for reptiles.

Swanton Novers Wood comprises four blocks of ancient woodland, all likely to be of primary origin. They form what is considered one of the most important groups of woods in the country, as they include many woodland stand-types, several of which are nationally uncommon. The plants, BRYOPHYTES, fungi and lichens are diverse and include uncommon species. Plus the breeding birds and INVERTEBRATES are also diverse and interesting.

The **North Norfolk Coast SSSI** comprises a wide range of coastal habitats and species, with many rare and local species occurring. The area "constitutes one of the largest expanses of undeveloped coastal habitat of its type in Europe."

Information and quotes taken from Natural England citations

Holt Lowes © Evelyn Simak and licensed for reuse under this Creative Commons Licence

The North Norfolk Coast © Trevor Wright and licensed for reuse under this Creative Commons Licence

SSSI Condition Monitoring

SSSIs are managed by Natural England who regularly assesses their condition under six categories:

- ***Favourable*:** This means the site is being adequately conserved and is meeting its conservation objectives.
***Unfavourable Recovering*:** All the necessary management measures are in place on the site and provided that this is sustained, favourable condition will be reached in time.
***Unfavourable No Change*:** The site is not being conserved and is in poor, but not worsening condition. The longer it remains in this state the more difficult it is likely to be to achieve recovery.
***Unfavourable Declining*:** The site condition is becoming progressively worse and changes to site management or external pressures are needed to reverse this.
***Part Destroyed*:** Part of the special interest feature of the site has suffered lasting damage and will never recover.
***Destroyed*:** All of the special interest feature of the site has suffered lasting damage and will never recover.

(Information taken from the Natural England website: http://www.sssi.naturalengland.org.uk/special/sssi/glossary.cfm)

Table 3: The condition of SSSIs within the Glaven catchment

SSSI	Condition*	Last Monitored
Bilsey Hill	Unfavourable Recovering	Jan 2012
Glandford (Hurdle Lane)	Favourable	Apr 2008
Glandford (Letheringsett Road)	Favourable	Jun 2013
Holt Lowes	Unfavourable Recovering	Feb 2010
Kelling Heath	Unfavourable Recovering	May 2009
North Norfolk Coast	Favourable (99.40% of area) Unfavourable Recovering (0.6% of area)	2009-2012
Swanton Novers Wood	Unfavourable No Change (84.63% of area) Unfavourable Recovering (15.37% of area)	Sep 2011
Wiveton Downs	Favourable	Jun-Jul 2011

* See 'SSSI Condition' box above for further information

Roadside Nature Reserves

Roadside Nature Reserves (RNRs) are stretches of road verge designated for their ecological interest. Many contain the last remaining fragments of old unimproved grassland that was once widespread, and often hold rare or unusual plants. The RNR scheme is run by Norfolk County Council, and although the designation is non-statutory, the RNRs are individually managed to protect the plants and animals living there. There are **three** RNRs within the Glaven Catchment covering a total length of over **1.2km**. These are at Cley-next-the-Sea, Hempstead and Wiveton.

County Wildlife Sites

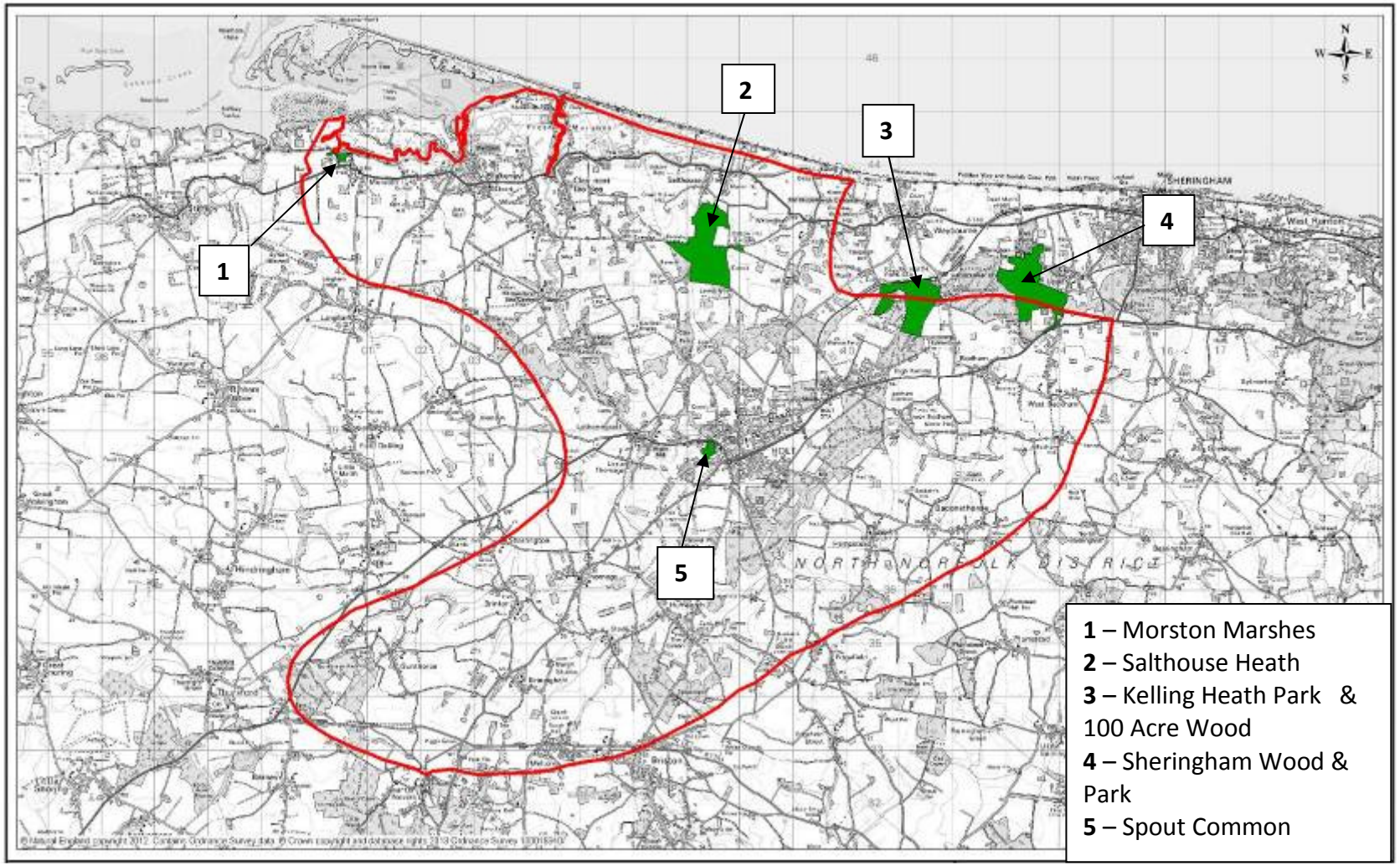
County Wildlife Sites (CWS) are particularly important sites for wildlife in Norfolk. There are **43** CWS in the Glaven catchment, covering an area of **544.9 ha**. The River Glaven itself is a County Wildlife Site. Many CWS are privately owned and do not allow public access. However **five** of them are publicly accessible (see pg 11).

County Wildlife Site Monitoring

County Wildlife Sites are monitored every year to determine what percentage are in Positive Conservation Management. The statistic for each district is reported to central government.

Being in Positive Conservation Management means that a site is actively being maintained or improved for the species for which is designated as important. This is often achieved through Environmental Stewardship schemes. Such schemes are run by Defra, and they encourage farmers and landowners to manage their land in a way that provides benefits to the environment alongside the traditional farming outputs such as crops and livestock.

In the reporting year 2012/13, of the 43 County Wildlife Sites within or overlapping the Glaven catchment **32** of them (**74.4%**) were in positive conservation management and **11** of them (**25.6%**) were not.



County Wildlife Sites with public access within the Glaven catchment

1 – Morston Marshes: (3.5ha). An area of high level salt marsh surrounding an offshoot of Morston Creek, grading to dry neutral grassland and dense scrub. Saltmarsh species present include Sea Couch, Glasswort, Annual Sea-Blite, Sea Purslane, Greater Sea-Spurrey and Sea-Lavender.
The site can be reached from Quay Lane, off the main A149 coast road.

2 – Salthouse Heath: (99.2ha). A moderately large coastal heath situated on a GLACIAL OUTWASH PLAIN of sand and gravels, important for birds and reptiles. The dry dwarf-shrub heath is dominated by Common Heather interspersed with Western Gorse and occasional Bell Heather.
There is a small parking area off Bard Hill, or park in the village or at the beach car park and walk up.


Salthouse Heath © Ajay Tegala and licensed for reuse under this Creative Commons Licence

3 – Kelling Heath Park & 100 Acre Wood: (65.3ha). A large site comprising semi-natural broadleaved woodland, and dry heath with associated scrub. The site is primarily used as a caravan park.
The site can be accessed from Sandy Hill Lane, or from the Kelling Halt stop on the Sheringham – Holt steam train!


Morston Marshes © Ian Capper and licensed for reuse under this Creative Commons Licence

4 – Sheringham Wood & Park & Cracking Hill: (79.2ha). Sheringham Wood consists of predominantly 18th Century plantation with occasional patches of remnant ancient woodland. The Park lies to the north of this and is made up of acid and calcareous grassland. Common-Spotted and Pyramidal Orchids are found in the more calcareous areas. Cracking Hill has patches of woodland flora in the understorey supporting bluebells, red campion and foxgloves.
The National Trust Car Park for Sheringham Park can be found off the B1157.


Sheringham Park © Stuart Warrington and licensed for reuse under this Creative Commons Licence

5 – Spout Common: (5.7ha). A site of grass and scrub. Springs seep from the valley sides feeding a small stream; these create wet flushes along the sides and in the valley bottom. Calcareous areas in the fen meadows contain common spotted orchid and southern marsh orchid. There are also many species of sedge along with Bog Bean, Marsh Arrowgrass and Spike-Rush.
The entrance to the site is off the A148, Letheringsett Hill

Information from County Wildlife Site citations

HABITATS AND LAND USE

A habitat is "an environment in which an organism or ecological community normally lives or occurs". While some species are able to live in a variety of habitats, there are others that can only survive in a particular habitat type. Land use describes how the land is being utilised by people.

Different habitats also provide different 'services' to people. For example woodlands provide timber and help absorb CO_2. Areas of grassland in built-up areas are important for flood prevention during heavy rain by allowing the excess water to soak into the ground. It is also known that getting out into nature helps people to unwind and relax from the stresses of daily life. This concept, known as 'ECOSYSTEM Services' is explained further below.

ECOSYSTEM Services

As humans we gain many benefits from natural ECOSYSTEMS. These are known as **ECOSYSTEM services** and they can be divided into four categories:

Provisioning – nature providing us with food, fuel, fresh water, natural medicines and biochemicals.
Regulating – nature providing services such as pollination, pest control, water purification and climate regulation.
Cultural – the non-material benefits of nature, such as spiritual enrichment, recreation and aesthetic experiences.
Supporting – nature providing services which underpin all the other ECOSYSTEM services, such as soil creation, nutrient cycling and photosynthesis.

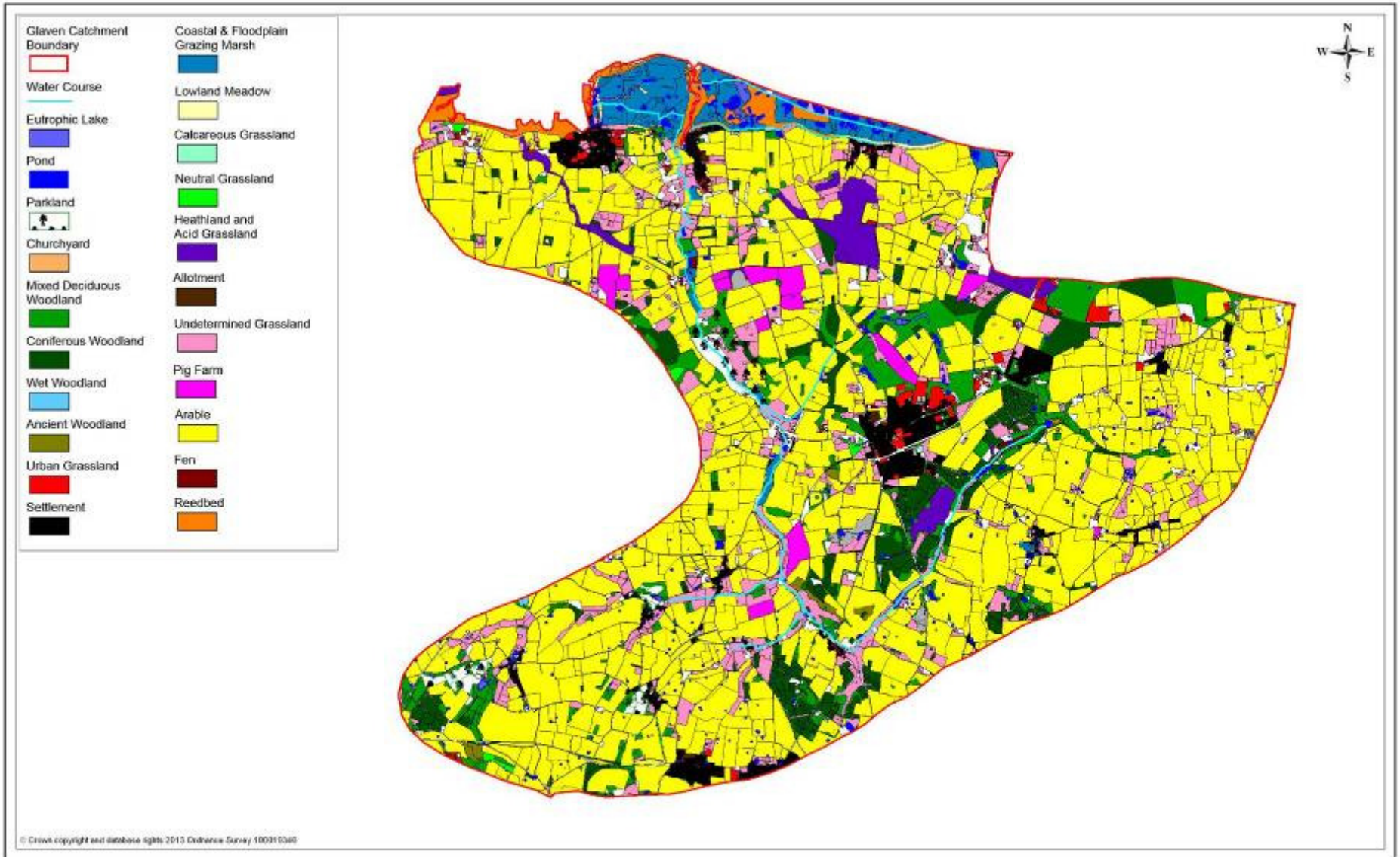
Over the last few years, more and more people have realised the importance of the natural world to the health, wellbeing and even the survival of humans. Many ECOSYSTEM services are being assigned monetary values, often based on how much it would cost to replace the service with a human-made alternative. This helps decision makers by expressing the value of an ECOSYSTEM in a tangible way, but can be controversial. Some people argue that the 'intrinsic value' of nature should be reason enough to conserve it.

Habitat and Land-Use Mapping

The map on page 16 shows the different habitat types (e.g. heathland, improved grassland, deciduous woodland etc) and land uses (e.g. arable land, parkland, churchyards etc) within the boundary of the Glaven catchment.

The habitats and land uses were mapped from a combination of aerial photographs and from the Natural England Priority Habitat Inventory information held by Norfolk Biodiversity Information Service. In some cases, exact habitat types could not be determined using these methods e.g. grassland not included in the Natural England Priority Habitat Inventories. In this case, the area was mapped as 'undetermined grassland'.

The final map was used to determine the overall area of each habitat and land-use type in the Glaven catchment. These areas can be compared over time to reveal losses or gains in particular habitats and land-uses.



Habitats and Land-Use in the Glaven Valley

Grassland

The main important grassland type within the Glaven Catchment is **Coastal and Floodplain Grazing Marsh** (**349.6ha**, **approx 3% of total area**). This Biodiversity Action Plan habitat is found both at the coast and along the river itself. Coastal and Floodplain Grazing Marsh is defined in the UK Biodiversity Action Plan as "periodically inundated pasture, or meadow with ditches which maintain the water levels, containing standing brackish or fresh water". It is usually grazed, or cut for hay or silage, and is important for both breeding and wintering birds.

Much of the habitat and land use mapping for the area was completed using aerial photos, which doesn't allow for different grassland types to be determined. Therefore any grassland areas not included in the Natural England Priority Habitat Inventory Mapping have been classified as **Undetermined Grassland** (**970.6ha, 8.7% of total area**).

Grazing marsh © Evelyn Simak and licensed for reuse under this Creative Commons Licence

Woodland

The Glaven Catchment contains both **deciduous (802.2ha, 7.2% of total area)** and **coniferous woodland (615.9ha, 5.5% of total area)**. Some are also classified as ancient woodland or wet woodland.

Wet woodland (2.2ha; 0.02% of total area) is important for many species. The high humidity levels are ideal for mosses to grow. Deadwood in association with water provides a unique habitat important for many INVERTEBRATES. Wet woodlands may also contain rare plants left from when the area was wet and open.

Ancient woodland (96.5ha; 0.86% of total area) is defined as an area that has been continuously wooded since at least 1600AD. It can include both semi-natural woodland and plantations on ancient woodland sites. Ancient woodland is rare – it is thought to cover just 3% of England's land area. It is also exceptionally rich in wildlife.

Woodland © David Kemp and licensed for reuse under this Creative Commons Licence

Chalk River

The River Glaven is a chalk river, which is a Biodiversity Action Plan Priority Habitat.

Chalk rivers are fed from groundwater aquifers, which produces clear water and stable conditions for river INVERTEBRATES and fish. Chalk rivers also have a characteristic plant community, and have shallow banks which support a range of water-loving plants.

Where the area approximately 50m either side of the river is not affected by intensive agriculture, fisheries or urban development, rich fen vegetation develops. This can be managed by grazing with cattle or let to naturally progress to CARR WOODLAND. These habitats are extremely valuable for insects and breeding birds.

The River Glaven has been artificially modified along much of its length over the years, which has affected its ecology. However some of the modifications are starting to be reversed thanks in part to the Norfolk rivers trust (see page 19)

River Glaven © Ian Capper and licensed for reuse under this Creative Commons Licence

The Norfolk Rivers Trust & The River Glaven – Jonah Tosney, NRT

Norfolk Rivers Trust are currently undertaking a lot of conservation work on the River Glaven, thanks largely to the hard work of the River Glaven Conservation Group, and as part of the 9 Chalk Rivers Project.

The Glaven is a Norfolk Chalk Stream, with the associated iconic wildlife including trout, otters, water-voles, kingfishers, native crayfish and eels. It faces a variety of ecological problems, all man-made. Historically the river has been straightened and dredged through much of its length to increase agricultural productivity in the valley. Although this has been successful in terms of food production, it has taken away the variety of habitats that should be associated with a chalk stream, disconnected the river from its floodplain and left it unable to manage its large silt and nutrient input.

Norfolk Rivers Trust has undertaken or is about to undertake the following restoration projects:

1. Habitat restoration at Wiveton with the River Glaven Fishing Association and the Environment Agency. New RIFFLES have been constructed in the dredged channel, improving habitat for fish and INVERTEBRATES. Complete.
2. Silt removal from Bayfield Lake – to improve the habitat and water quality of the lake. Complete.
3. Re-meandering of a "buried" channel at Bayfield – on-going.
4. Improving channel and floodplain habitat at Little Thornage – due March 2014.
5. Restoration of Selbrigg Pond – on-going work to protect and restore a clean water biodiversity hotspot.
6. Working with farmers in the headwaters to reduce silt input to the river – on-going.
7. Restoration of Baconsthorpe Moat – possible project for 2015 to restore the moat and enhance its function as a silt trap in the upper catchment.

In addition to these projects the River Glaven Conservation Group and Wild Trout Trust have also re-meandered stretches of river at Hunworth and Little Thornage and re-connected the river to its floodplain, improving plant and invertebrate biodiversity, installed a fish pass at Glandford and naturalised a stretch of river also at Glandford.

Bayfield Lake © Christine Matthews and licensed for reuse under this Creative Commons Licence

Kingfisher © Peter Trimming and licensed for reuse under this Creative Commons Licence

Meanders on the Glaven © Evelyn Simak and licensed for reuse under this Creative Commons Licence

Heathland

There are two main areas of heathland within the Glaven Catchment - Salthouse Heath and Holt Lowes. Heathland areas in Norfolk are often found in a mosaic with acid grassland. The total area of **Heathland and Acid Grassland** within the Glaven Catchment is **224ha (2.0% of total area)**. Heathland is a declining habitat in England. Only a sixth of the heathland that was present in 1800 still remains. In Norfolk, the decline in heathland and acid grassland is estimated to be about 75%. Declines are often due to a lack of management – particularly under-grazing and abandonment – which leads to the sites becoming taken over by scrub. Heathland is also an important habitat for biodiversity. In Norfolk, bird species designated as Biodiversity Action Plan Species which are associated with heathland include nightjar, woodlark, red-backed shrike, skylark and grey partridge. Important heathland invertebrates include silver-studded blue butterfly and the solitary wasp *Cerceris quinquefasciata*.

Salthouse Heath © Ed Stocker

Holt Lowes © Evelyn Simak and licensed for reuse under this Creative Commons Licence

Arable areas can sometimes seem boring, bare and devoid of wildlife. However if they are managed well they support important species, some of which are found nowhere else. There are **6580.4ha** of arable land in the Glaven Catchment – the largest area of any habitat or land-use type, and 58.7% of the total area of the Glaven Catchment.

Arable field margin © Norfolk County Council.

Ponds are often overlooked as small and insignificant, particularly in a farmland landscape, but are vital habitats for many species. There are **485** ponds ($1m^2$ - 2ha in area) within the Glaven Catchment.

Pond Restoration in the Glaven Catchment – Carl Sayer, UCL

Ponds in agricultural landscapes have the potential to act as biodiversity hotspots and are important for the conservation of aquatic species including water plants, mosses, INVERTEBRATES, amphibians and fish. However, the quality of farmland ponds can be compromised if they are enriched by nutrient run-off from surrounding agricultural land and/or if they become heavily overgrown by trees and bushes. Both of these factors can result in a lack of water plants and excessively low concentrations of oxygen such that ponds become extremely species-poor.

The catchment of the River Glaven contains hundreds of small farmland ponds, but many of them are overgrown and neglected. The potential for pond restoration in the catchment is demonstrated by Manor Farm, Briston. Manor Farm straddles the upper reaches of the rivers Glaven and Bure and contains around 40 ponds within its 243 hectares. Since the 1960s, custodian Richard Waddingham has managed the Manor Farm ponds through the periodic cutting back of trees and bushes and sometimes through the removal of sediment. Each year the ponds are assessed and 3-4 are selected for management. Recent studies by University College London show the Manor Farm ponds to support exceptionally high aquatic biodiversity, with a peak in the number of species present 3-5 years after management.

Breeding populations of Great Crested Newt *(Triturus cristatus)* have been recorded in 28 of the Manor Farm ponds, which, among other groups, are also home to 23 submerged and floating-leaved water plants, 20 dragonflies and 14 species of wild duck – that's a lot of species.

More recently the Manor Farm model of pond management has been applied to other ponds in the Glaven catchment, including Sayer's Black Pit, which has again shown dramatic increases in the number of species present after management - see Table 4 (next page) for preliminary results.

Sayers Black Pit before (above) and after (right) management ©Carl Sayer.

Pond at Manor Farm © Carl Sayer.

Table 4: Preliminary results from species surveys of Sayers Black Pit before and after management
* indicates that breeding behaviour was observed.

	Before restoration (2010-2011)	After restoration (2012-2013)
Aquatic MACROPHYTES		
Potamogeton natans		√
Potamogeton berchtoldii		√
Potamogeton crispus		√
Ranunculus aquatilis		√
Ranunculus sceleratus		√
Lemna minor		√
Lemna trisulca		√
Alisma plantago-aquatica		√
Chara vulgaris		√
Aquatic mosses		√
Dragonflies		
Common Darter	√	√*
Large Red Damselfly		√
Azure Damselfly		√*
Common Blue Damselfly		√*
Blue-tailed Damselfly		√*
Small Red-eyed Damselfly		√
Emperor Dragonfly	√	√*
Broad-bodied Chaser		√*
Ruddy Darter		√*
Banded Demoiselle		√
Four-spotted Chaser		√
Southern Hawker		√*
Emerald Damselfy		√*
Scarce Emerald Damselfy		√
Amphibians		
Common Toad		√*
Common Frog		√*
Smooth Newt		√*
Great crested Newt		√*

The Wild Trout Trust and the River Glaven – Tim Jacklin, The Wild Trout Trust

The Wild Trout Trust (WTT) is a small charity which inspires and helps people to protect wild trout and their habitat. We have been involved in a number of projects on the River Glaven, the first dating back to 2006 at Little Thornage meadow, where a partnership with the River Glaven Conservation Group (RGCG) and Environment Agency (EA) improved the habitat along a 1-km river length. The improvements at Little Thornage included removal of embanked spoil from along the river banks, allowing more frequent inundation of the floodplain at higher flows; this restores a natural river process, benefitting wildlife and providing flood storage capacity to protect downstream properties. Gravel and "woody debris" were also added to the channel to restore fish spawning areas and improve in-stream habitats for species such as native white-clawed crayfish, brook lampreys, bullheads, eels, brown trout, water voles and otters.

A major river restoration project was completed on the Glaven in August 2010. The work was a partnership effort between the landowners, Stody Estate, and Wild Trout Trust, Environment Agency, Norfolk Wildlife Trust, River Glaven Conservation Group, University College of London, the Centre for Environment Fisheries and Aquaculture Science (CEFAS) and Professor Richard Hey.
The project took place on a 400-metre reach which, at sometime in the distant past, had been straightened and moved to the edge of the floodplain, probably for the purposes of milling. The project involved restoring the river's natural form by putting back pools, RIFFLES, and MEANDERS, narrowing the river and reconnecting it with its flood plain. The restoration was designed and closely supervised by Professor Richard Hey, a professional FLUVIAL GEOMORPHOLOGIST.
Before work commenced, the site already contained a number of species of conservation interest. Detailed planning was required to minimise the impact of the works upon the existing biodiversity of the site. Close co-operation between Wild Trout Trust, Norfolk Wildlife Trust and the Environment Agency ensured the works were carried out sensitively and at the appropriate time of year. On completion, the surrounding land was put into Higher Level Stewardship and a number of studies have been carried out by researchers from University College London, Queen Mary University of London, CEFAS and the Environment Agency.

A strong theme running through the WTT's work on the River Glaven has been partnership. It would not have been possible to complete any of the above projects without the support of the many partners mentioned above and the WTT is looking forward to continuing to work with them to improve the River Glaven in the future.

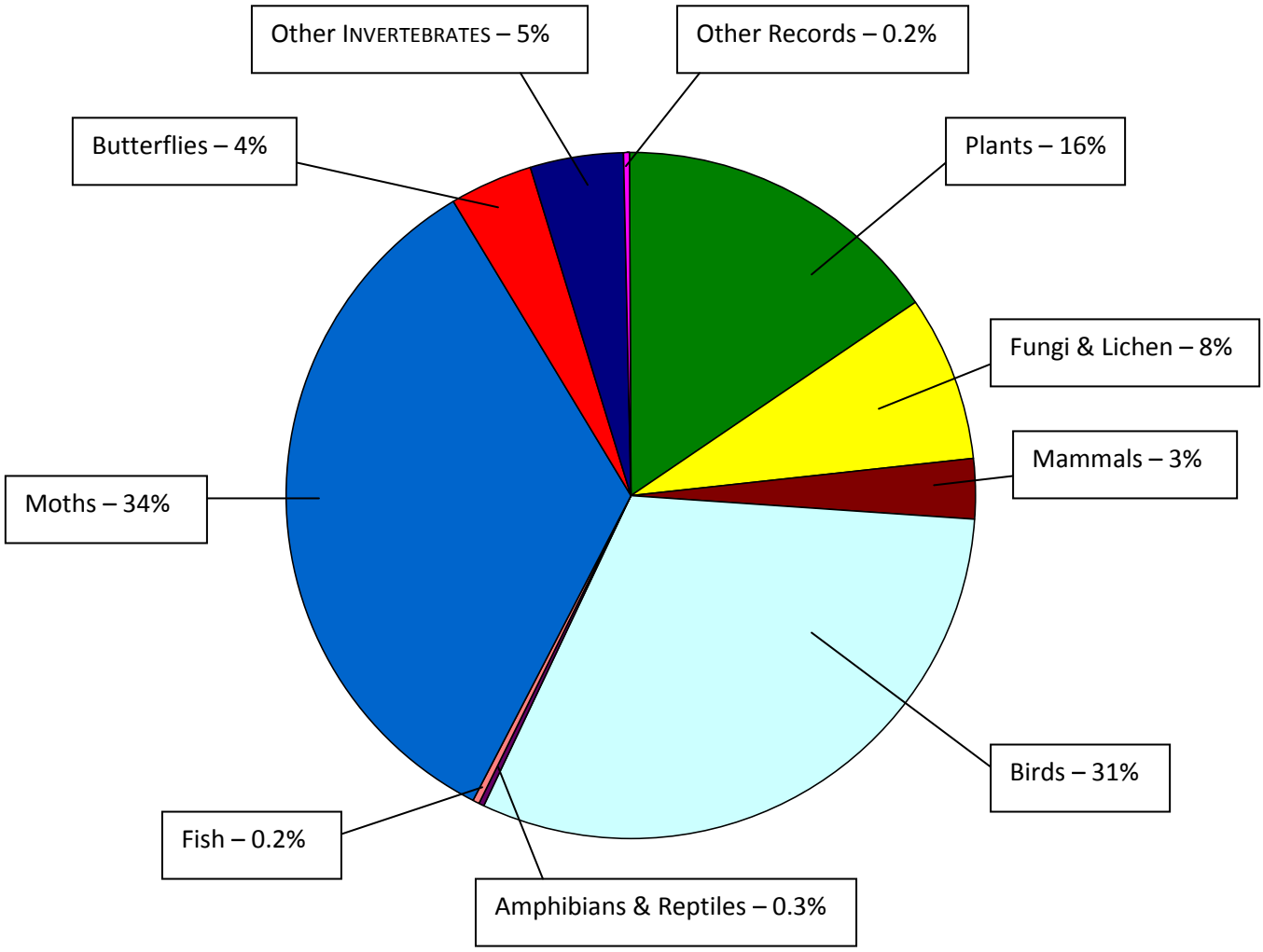

Spoil bank removal at Little Thornage © Tim Jacklin


Recreating meanders © Tim Jacklin

SPECIES

There are thousands of species which call the Glaven catchment home. From the tree bumblebee to the grey seal, from the brightly coloured brimstone butterfly to the unassuming Bracken Map fungus, NBIS holds **105373** individual records of **5347** species from within the Glaven catchment.

This chart shows the percentage of the total number of species records made up by each group of species (plants, mammals, birds etc) recorded in the Glaven catchment. [Based on the data held by Norfolk Biodiversity Information Service, July 2013]



You can see from the graph that our records are dominated by species of birds and moths. This is not surprising since the North Norfolk coast is a magnet for birdwatchers, who generate large numbers of records, plus moth trapping is also relatively popular and it is possible to catch a large number of species in one night of trapping. Another possible reason that these groups dominate the records is because there are large numbers of species of birds and moths found in this area of Norfolk. On the other hand, fish are difficult to identify and record, which may explain why fish records make up just 0.2% of the total records for the Glaven catchment.

Rare Species

450 of the species recorded in the Glaven catchment since 2000 are what would be classed as **'Species of Conservation Concern'**. These are species that are rare or scarce, or that are protected by law. They include **8** species of flowering plants and **29** species of mammals. It is important to know where these species are found in order to protect them from further decline. For more information on how you can get involved in species recording see pg 38.

Otters in the Glaven Catchment

Only ten years ago, signs of otters were rare in the Glaven Valley. However today there are regular sightings, and spraints (droppings) are being found all over the place – by the river, ditches and ponds.

A study was conducted to compare the diets of the otters present in the Glaven Catchment today with that of otters from the 1970s (based on studies by Weir & Bannister). Spraints were collected and analysed between 2009-2010.

The studies in the 1970s showed the otters to be feeding largely on eels and stickleback. However the proportion of these species in the diet had decreased in the more recent study. Instead, otters were found to have been eating white-clawed crayfish, brown trout, fish such as roach, rudd, common carp and perch, water birds (especially duck, coot and moorhen) and amphibians (particularly in spring).

It is likely that these observed changes in diet reflect changes in the abundance of prey species, particularly the decline of eels.

Otter © Peter Trimming and licensed for reuse under this Creative Commons Licence

Information Sources:
Almeida D, Copp GH, Masson L, Miranda R, Murai M & Sayer CD (2012). *Changes in the diet of a recovering Eurasian otter population between the 1970s and 2010.* Aquatic Conservation: Marine and Freshwater Ecosystems **22**: 26-35.
and
Sayer C, Almeida D, Copp G, Sayer D, Linford T, Cornwall C & Murai M (2011) *What do otters eat in the Glaven Catchment?* River Glaven Conservation Group Newsletter Spring 2011.

Biodiversity Action Plan Priority species

Biodiversity Action Plan (BAP) Priority species are a priority for conservation in the UK based on their international importance, rapid decline and high risk of further decline and extinction. The list was revised in 2007 and now includes 1150 species.

171 of the Species of Conservation Concern in the Glaven Catchment are **Biodiversity Action Plan Priority species**.

Crucian Carp – a Norfolk BAP Species

Crucian carp (*Carassius carassius*) is a crypic freshwater fish, normally olive golden-brown in colour, which is characteristic of ponds and river backwaters. It is classified in the IUCN Red List of Threatened Species as 'Least Concern', but with the caveat that the population trend is decreasing. Norfolk and northern Suffolk are thought to be a stronghold for the species, although it is not found in the Broads.

A study was undertaken in the Glaven catchment by Carl Sayer and colleagues in 2011 to investigate the decline of crucian carp in ponds and to determine the cause of these declines. Of the ponds studied, approximately 40 of them were known to contain crucian carp in the 1970s-1980s (determined from local knowledge). The study showed a 72% decline in the species, with crucian carp only being found in 11 ponds. Non-native related fish species (goldfish, *Carassius auratus*, and common carp, *Cyprinus carpio*) and their hybrids with crucian Carp were found in 20% of the ponds.

Causes of local extinction of crucian Carp were determined as "dessication due to drought, terrestrialization, habitat deterioration, hybridisation and competition with non-native cyprinids, agricultural land reclamation and predation (after the introduction of pike (*Esox lucius*)."

As a result of this study, crucian carp has been designated as a Biodiversity Action Plan (BAP) species in Norfolk. The plan aims to double both the range of the species in North Norfolk, and also the proportion of ponds in North Norfolk (known previously to contain the species) containing self-sustaining populations. This will be achieved through restocking and habitat enhancements.

Information source: Sayer CD, Copp GH, Emson D, Godard MJ, Zieba G & Wesley KJ (2011). *Towards the conservation of crucian carp Carassius carassius: understanding the extent and causes of decline within part of its native English range*. Journal of Fish Biology **79**: 1608-1624.

Crucian Carp © Carl Sayer

Invasive Non-native Species

Sixteen of the species recorded in the Glaven catchment since 2000 are **invasive non-native species**. These have been introduced to the area by people and have a tendency to spread rapidly and cause problems for our native wildlife. Knowing where they are enables conservationists to keep a check on their distribution and intervene before they start causing a problem. The Norfolk Non-Native Species Initiative co-ordinates this work.

Crayfish in the River Glaven – Mike Sutton-Croft, Norfolk Non-Native Species Initiative

The white-clawed crayfish is a rare and fascinating freshwater invertebrate, and the only native species of crayfish in the UK. Since the 1970s there has been a 50% decline in the range of white-clawed crayfish in England and Wales, a decline that has largely been attributed to the introduction of non-native species of crayfish. There are currently at least 6 species of non-native crayfish present in England. Of these the American signal crayfish has had the most detrimental impact on populations of white-clawed crayfish. This species was introduced in the 1970's to be farmed for food, and not only outcompetes and predates on the smaller native species but also spreads a fungal pathogen - 'crayfish plague'. This disease is fatal to white-clawed crayfish, but not to signal crayfish, and can also be spread by humans on equipment such as fishing nets and crayfish traps.

Around the turn of the millennium the status of the white-clawed crayfish in the River Glaven was uncertain, but a survey of the river in 2006 revealed that the catchment not only contained white-clawed crayfish, but that they were thriving! With the disappearance of this species from so many other rivers across the country, the River Glaven became one of the most important rivers for white-clawed crayfish in Norfolk and the wider region. A survey of the adjacent River Stiffkey in 2009 revealed no populations of white-clawed crayfish, despite there being historical records of the species from the catchment and the habitat seeming to be suitable. This meant that there was a golden opportunity to establish a new population in this river using stock from the Glaven population. This approach – where new 'Ark' sites for white-clawed crayfish are established – is being encouraged by experts, who view it as crucial to ensuring the long-term survival of the species in the UK. The need to establish a new population of white-clawed crayfish in North Norfolk was made all the more urgent following the discovery of a large population of signal crayfish in a TRIBUTARY of the Glaven. It seemed as though it was only a matter of time before signal crayfish managed to get in to the main channel of the river, and sadly this happened in 2012, making the future of white-clawed crayfish on the Glaven far from certain.

There have been two translocations of white-clawed crayfish from the River Glaven to the River Stiffkey, one in 2011 and one in 2012. Re-surveys of the introduction sites have confirmed that a new population has been established, and we even found some baby crayfish in 2013! At the same time the population on the River Glaven seems to be holding its own, so it seems that we will continue to have white-clawed crayfish in Norfolk for a few years yet.

HISTORIC ENVIRONMENT

The historic environment encompasses all of the physical evidence and material remains that our ancestors have left on the landscape.
Within the Glaven Catchment there are records of **639** historic monuments, **445** 'find spots' (places where historic artefacts have been found) and **408** historic buildings. These records range from the Palaeolithic right through to Cold War monuments.

Prehistoric Activity in the Glaven Catchment – Kelly Powell, NCC Historic Environment Service

River valleys were often focal points for activity in prehistory and the Glaven is no exception. This activity is predominantly represented by funerary monuments and in particular the round barrows or mounds of the Neolithic and Bronze Age periods. These are perhaps best exemplified by the barrow cemetery on Salthouse Heath, the largest barrow group recorded in Norfolk. The dispersed cemetery covers approximately 1.6km by 1.2km of heathland; many of the barrows still stand and have been designated as Scheduled Monuments. Others beyond the heath have been destroyed by past agriculture but can be seen from the air as rings where the presence of infilled ditches which once surrounded the mounds have caused crops to grow at different rates.
Some of the barrows have been excavated and artefacts recovered suggest the cemetery was in use over 2000 years. A cluster of these standing barrows within the larger cemetery can be seen at Gallow Hill near Kelling. These have recently been cleared of vegetation and interpretation panels have been installed for visitors.


Barrow at Galley Hill following management, March 2010.
© David Robertson, Norfolk County Council

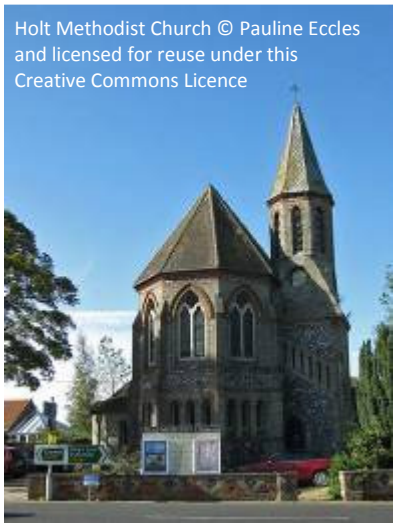
The focus of the Salthouse Heath cemetery appears to have been the river to the south and west and numerous other 'ring ditches' thought to represent plough levelled barrows can be seen from aerial photographs all along the Glaven valley.
Prehistoric occupation sites have also been identified in the Glaven catchment in Edgefield Woods near Hunworth. These survive as mounds and concentrations of burnt flint which may have been used for cooking or ritual purposes and are typical of prehistoric settlement sites.

Church Buildings within the Glaven Catchment

There are **27** historic church buildings within the Glaven Catchment, of varying ages and styles. The Holt Methodist Church is an excellent example of Gothic revival architecture, built of red and white brick and blue flint. St Mary's Church in Stody is probably 11th century in origin, with a round west tower and interesting floor tombs inside. A group of spectacular perpendicular churches (such as St Nicholas' Church in Salthouse) are found in the area where the Glaven exits into the sea. This relates to the prosperous medieval harbours that existed here (see page 30). The tower of All Saints' Church in Morston was damaged by lightning in 1743, and the whole building was restored in the 19th century, while the Gothic revival flint building of High Kelling Church was built in 1901, originally as the chapel of a children's hospital. Briningham Church is unusual in having a south west porch tower (instead of the usual west tower). Most of the church dates from the 13th and 14th centuries. Inside, there is a 14th century font and the remains, partly destroyed, of a bell frame of about 1300. The churchyard has interesting gravestones, including one in the shape of a pyramid, topped with the head of a muzzled bear.

Information from Norfolk Heritage Explorer website & Norfolk County Council Historic Environment Service.

St Nicholas' Church, Salthouse © Adrian S Pye and licensed for reuse under this Creative Commons Licence



Holt Methodist Church © Pauline Eccles and licensed for reuse under this Creative Commons Licence

St Mary's Church, Stody © Adrian S Pye and licensed for reuse under this Creative Commons Licence

All Saints' Church, Morston © Adrian S Pye and licensed for reuse under this Creative Commons Licence

The Medieval Ports of the Glaven – Kelly Powell, NCC Historic Environment Service

The Glaven ports (Blakeney (Snitterley), Cley, and Wiveton) brought much prosperity to the area in the medieval and post medieval periods. Although currently sheltered behind Blakeney Point, the mouth of the Glaven was once an open estuary and in the 12th century the approach channel was deepened to encourage shipping. Written records show Cley and Blakeney were well established ports by the mid-13th administering both coastal and foreign trade. The Glaven ports were not 'staple ports' and therefore not allowed to trade in the wool and cloth that had made East Anglia's larger ports wealthy; they therefore traded primarily in fish. Historic documents suggest the Glaven ports were important for supplying fish to London (including the king's household) as well as Norwich. The significance of the Glaven ports can be seen in Blakeney Guildhall - the remains of the house of a prosperous Blakeney merchant, with a fine 15th century brick-vaulted undercroft, which later became the guildhall of Blakeney's guild of fish merchants. The prosperity of the ports is also reflected in the fabulous perpendicular churches of Blakeney, Cley, Wiveton and Salthouse. These churches also house one of the finest collections of medieval ship graffiti anywhere in the country. Other signs of this forgotten splendour include Wiveton Bridge - a stone and brick bridge of about 1500 which bridges the Glaven between Wiveton and Cley. Excavations in the village of Wiveton in recent years have uncovered a further undercroft and a possible wharf area.

The ports declined in later periods due to a number of factors including the Black Death, French Wars and localised erosion and silting. Trade became predominantly coastal until the 17th century when a local landowner built an embankment across the river to reclaim salt marshes, causing the harbour to silt up. Today the ever growing spit of Blakeney Point covers the mouth of the harbour.

Other uses of the harbour at Cley can be seen from the air in the form of 'salterns' – mounds of debris resulting from the saltmaking process which may date to the medieval or post medieval periods.

Blakeney Guildhall Undercroft © Ashley Dace and licensed for reuse under this Creative Commons Licence

Wiveton Bridge © Evelyn Simak and licensed for reuse under this Creative Commons Licence

Medieval Castles in the Glaven – Kelly Powell, NCC Historic Environment Service

The Glaven catchment contains two very different medieval castles. Hunworth Castle overlooks the river on the opposite side to the modern village of Hunworth. The castle is made up a circular enclosure surrounded by a bank and ditch, with an entrance to the North West, and is a type of Norman castle known as a ringwork. Unusually very little is known about the castle, although it is thought to have been built either soon after the conquest or under King Stephen in the 12th century when many castles were built without license. Excavations in the 1960s suggest the castle was in use for a very short period of time.

In contrast Baconsthorpe Castle in the east of the catchment area is a 15th century fortified manor house and tower surrounded by a moat. Surviving buildings on the platform include an inner gatehouse, a stretch of curtain wall and a roofless building. The castle was founded by John Heydon I in c. AD 1450 and was completed by his son Sir Henry in AD 1486. It has only recently been described as a 'castle' rather than 'hall'. Sir Christopher Heydon added the outer gatehouse in AD 1551 and part of this survives having been converted into a house in the 17th century. At some point after 1588 the eastern arm of the moat was expanded to create a large mere. A complex of earthworks exists beyond the moated area representing enclosures, water features and formal gardens. A license to crenellate (in effect to make the house a castle) was obtained in 1561 but is thought to have been a status symbol rather than a serious fortification. The site is in the guardianship of English Heritage and is open to the public.

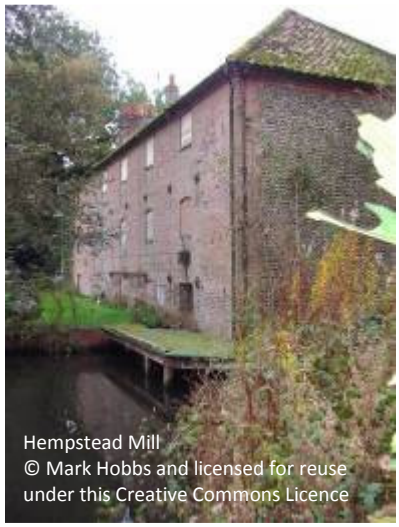
Baconsthorpe Castle © Norfolk County Council Historic Environment Service

Watermills

At the time of the Domesday Book there were 16 watermills along the length of the River Glaven. Today there are six, and only one of these is still a working watermill.

Hempstead Mill

Present building first recorded in 1839. The original watercourse was moved some 40 yards southwards to better accommodate the mill. This meant that the Glaven was effectively dammed; forming the large lake that still exists above the mill today. After a number of boundary disputes resulting from the alterations to the watercourse the mill became known as Holt Mill despite being in Hempstead.



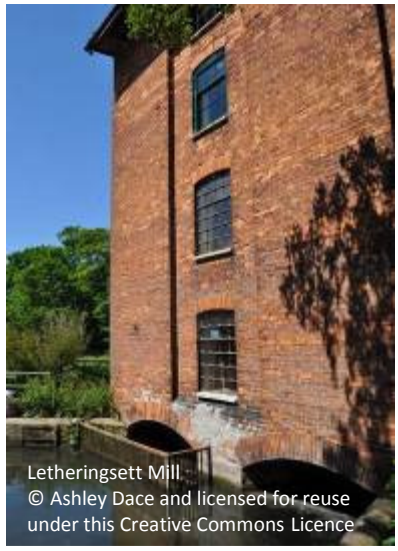
Hempstead Mill
© Mark Hobbs and licensed for reuse under this Creative Commons Licence

Hunworth Mill

While the building dates from around 1760, there was a mill in Hunworth as far back as Saxon times, with milling dues having been paid since the time of Edward the Confessor. The mill is the only example in Norfolk where the power to the millstones was delivered from above. The mill sat disused for some 80 years and at one point lay almost derelict. However it was restored and sold at auction in 1974 by Savills as a private residence.

Thornage Mill

Late 18th or early 19th century in date and possibly located on a site mentioned in the Domesday Book, and known as 'Feldmille' in the 1200s. The course of the Glaven was altered so the mill could be constructed in an area able to hold the mill dam without flooding the surrounding area. Disused since 1938, the mill was sold in the 1980s and converted to a private residence.



Letheringsett Mill
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Letheringsett Mill

The last remaining working watermill in Norfolk!
A mill in Letheringsett was mentioned in the Domesday Book; this structure was built in 1802 following fires in the previous two mills on this site. The current owners bought it in 1987 and restored it to working order. The mill is open to the public and working throughout the year. See www.letheringsettwatermill.co.uk for more information.

Letheringsett Brewery Mill

This was a later addition to the maltings and brewery complex, originally constructed as a malt mill. The first ground wheat from the mill was sold as flour in December 1784, and was eventually sold as far afield as Newcastle. The mill and adjacent maltings were sold to Morgan's brewery in 1896. Damaged by fire in 1936 the maltings complex became derelict by 2003.

Glandford Mill

Mentioned in the 17th century, the current building was built in around 1907 using local flint. When the mill was sold in 1969 the wheel had already gone and the mill was used as a store. It was then converted into a residence and in the running of a fish farming business – though flooding in 1974 resulted in heavy losses.

Glandford Mill
© Evelyn Simak and licensed for reuse under this Creative Commons Licence

Source: www.norfolkmills.co.uk and Norfolk Historic Environment Service

Deserted medieval village of Burgh Parva & St Mary's Church

Burgh Parva was formally a hamlet of Melton Constable, which was gradually deserted over the medieval period. Today, all that exists of the village are the ruins of St Mary's Church.

The church tower is still almost complete, and remnants of the chancel and nave can still be seen. The first record of the St Mary's was in the early 14th century when there were only about 15 households.
The brick in the tower suggests it was completed in the early 16th century. However after the Reformation, it was decided that the area could not support two Anglican churches, so St Mary's was merged with Melton church and fell into ruins.


The 'tin tabernacle' with the ruins of St Mary's behind © John Salmon and licensed for reuse under this Creative Commons Licence

After the construction of the railway, the population of Melton Constable increased rapidly. Faced with the threat of non-conformists, the Church of England wanted an Anglican church closer to the urban population, as the existing Parish church was situated a mile or so out on the estate of the Hall. As a result a temporary corrugated iron church (a 'tin tabernacle') was consecrated in 1903 and it is still standing and used for services to this day.

Weybourne Camp

This is situated on the far northeast edge of the Glaven Catchment area.
It is the site of a World War II and post war Weybourne Anti Aircraft Training Camp. Originally just a temporary summer camp set up for the territorial army in 1935. In 1937 it was decided to make the camp permanent and so more fixed structures and defences were erected. The camp closed in 1959.

During World War II the camp was surrounded by a perimeter anti-tank ditch and defended by gun emplacements and barbed wire. The cliff top to the north was covered by a line of heavy anti aircraft guns and batteries, slit trenches and pillboxes.

There are also possible earthworks and documentary references to Armada defences and fortifications along the coast in this area. It is possible that the maps and references refer to defences planned and not necessarily built. However a coastal survey carried out in recent years identified standing earthworks which may be the remains of a fort marked on a pre Armada map of 1588 as 'Black Joy Forte'
Source: http://www.heritage.norfolk.gov.uk/

WATER QUALITY

Measuring the quality of the water in the River Glaven gives an indication of how healthy the river is. It shows the effect of habitat restoration work on the river, and also means that where water quality levels are not as high as they should be, measures can be put in place to improve them.

The Environment Agency monitors the water quality of rivers in order to assess them against the standards set out in the WATER FRAMEWORK DIRECTIVE. These standards allow the river to be classified as having 'High', 'Good', 'Moderate', 'Poor' or 'Bad' ecological status. 'High' means the conditions are largely undisturbed.

Monitoring takes into account the populations of fish and INVERTEBRATES present, the levels of dissolved oxygen, phosphate and ammonia in the water, and the pH of the river.

The current overall ecological status of the Glaven River is **GOOD**.
The current overall ecological status of the Gunthorpe Stream is **MODERATE**.

Table 5: The ecological status of the River Glaven (data from the Environment Agency website)

Fish	INVERTEBRATES	Ammonia	Dissolved Oxygen	pH	Phosphate
Moderate	Good	High	Good	High	High

The Glaven has:

- High levels of dissolved oxygen, which are needed so that the aquatic life in the river can survive.
- Very low concentrations of ammonia, indicating low pollution levels.
- Low concentrations of phosphate, meaning the ecological balance of the river is not disturbed.
- MACROINVERTEBRATES including stonefly, yellow may and sand fly. These species need fast-flowing, non-polluted water with plenty of oxygen to survive.
- Nine species of fish, and a number of protected species, showing the positive impact of recent habitat restoration.

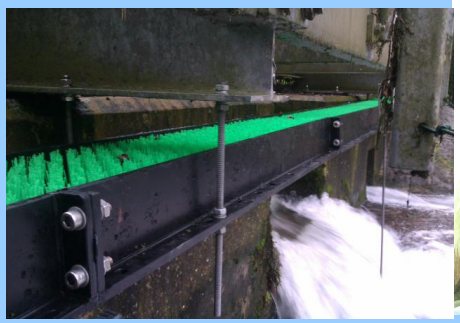
Source: Environment Agency River Glaven leaflet

Improving the River Glaven for Fish and Eel Passage

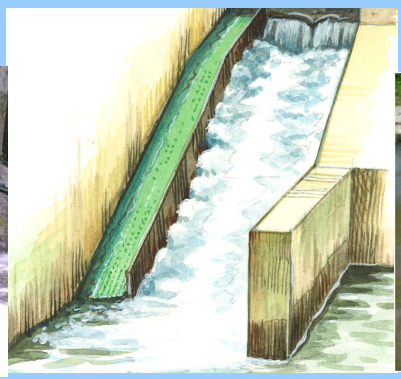
The Glaven flows directly into the North Sea, and has good upstream habitat for eel and migratory SALMONID FISH. It is widely known that eel populations have dropped dramatically in recent years, and sea trout numbers are also falling. One of the reasons for this decline in numbers is thought to be barriers to upstream migration. In common with the majority of rivers in East Anglia, the Glaven has a number of structures which prevent, or at best, delay, fish and eel migration upstream. These structures consist of tide gates, watermills, weirs and sluices.

Tidal Gates are the priorities for eel and fish passage. Tidal sluices can take various forms, but on the Glaven at Cley they are vertical, side-hinged gates. The gates only close at high tides and allow sufficient tidal incursion to not be considered an obstruction to upstream migration of sea trout or eel.
The next barrier upstream is the Glaven outfall. This structure allows the Glaven to drain into the estuary but prevents salt water ingress, and is therefore regarded as the tidal limit. Flap valves of this type can be a considerable barrier to fish passage, but the fact that sea trout and eels are found upstream means that the flap is passable in some conditions.
There are engineering solutions available to make gates of this type more passable for all species. Dampers or spring retarders can be attached to maintain a gap large enough for sea trout and eels to enter for a longer period on the incoming tide, whilst not increasing flood risk. An alternative solution used on other gates (such as the tidal flap on the Stiffkey) is a Self-Regulating Tidal Gate which takes the form of a small flap within the tidal flap itself. This small flap stays open allowing fish passage at higher tide levels due to a buoyancy aid.
The Environment Agency are currently undertaking studies to assess how long the gates are open and whether this is enough to provide upstream migration before deciding whether any action is required.

Eel passage solutions can often be provided fairly simply and relatively cheaply, often with the installation of brushes to provide a substrate for ELVERS to climb up (see pictures below). Fish passage, however, is often far more challenging and expensive.
Whilst it is generally seen as beneficial to provide eel and fish passes on structures there are sometimes other issues to bear in mind. Native white clawed crayfish are found in the upstream reaches of the Glaven. Sadly, there is also a small population of invasive signal crayfish further downstream. If the signal crayfish gained access upstream it could be disastrous to the white clawed population as they are out-competed by signals, which also carry the crayfish plague which the white clawed are susceptible to. Certain structures are actually acting as a barrier to the movement of signal crayfish, as well as eels and fish. In effect these barriers are protecting (albeit perhaps temporarily) the native crayfish. In cases such as these the Environment Agency's policy is to not place fish and eel passes on these structures, but to try to protect the indigenous crayfish population.



© Environment Agency. Eel pass brushes

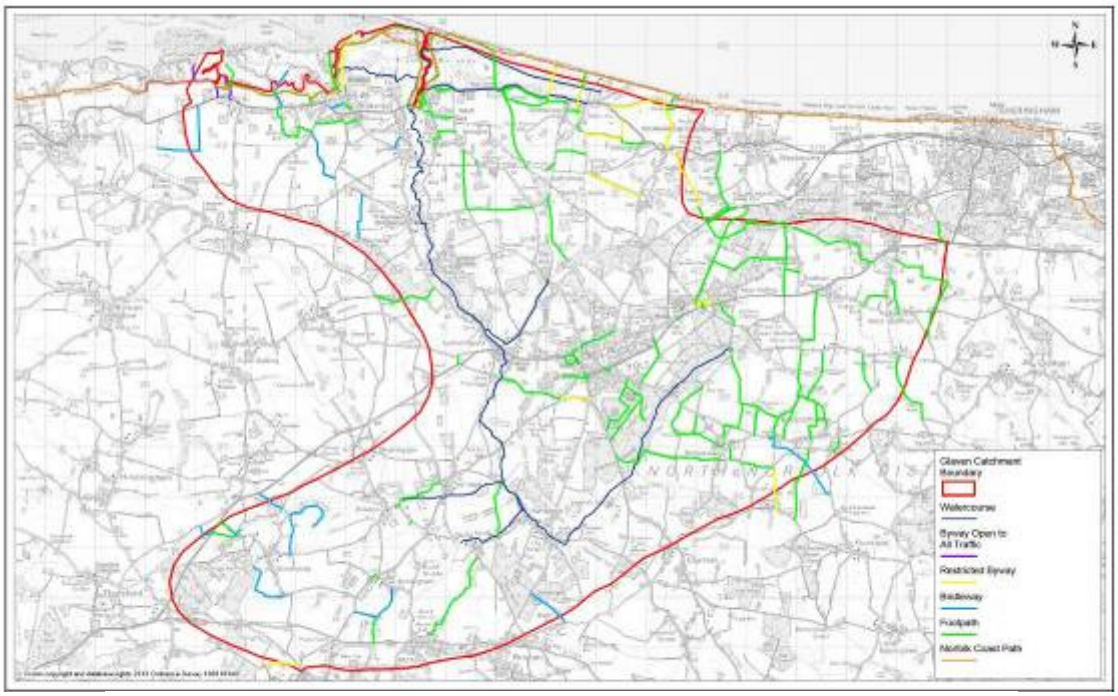


© Environment Agency. Illustration of a fish and eel pass.

© Environment Agency. An example of an eel pass

GETTING OUT IN THE GLAVEN CATCHMENT

There are lots of opportunities for getting out and enjoying the Glaven Catchment. There are over **80km** of public footpaths within the Glaven catchment, along with **13km** of bridleways, **10.5km** of restricted byways (restricted byways allow access on foot, horseback, cycling or any other non-mechanical vehicle) and **2.7km** of 'byways open to all traffic'.



Map showing the public rights of way within the Glaven catchment

The Norfolk Coast Path

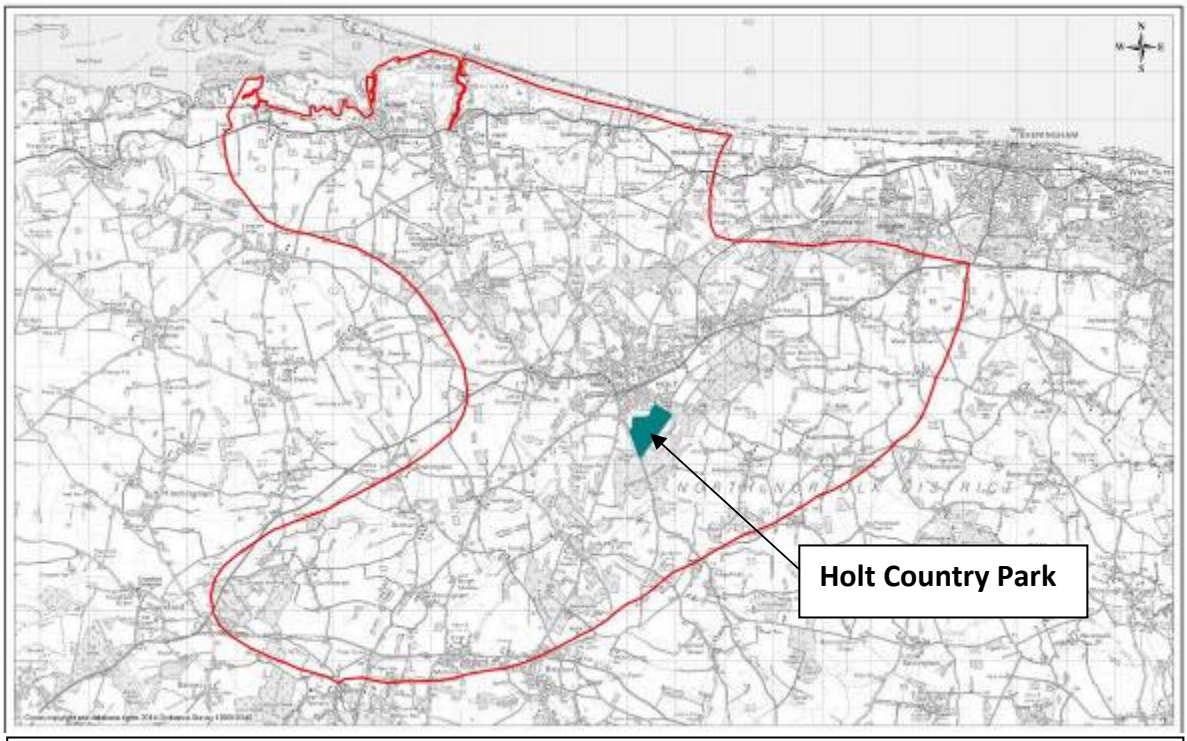
The Norfolk Coast Path runs for 42 miles between Hunstanton in the west and Cromer in the east. At Holme it combines with the Peddars Way and becomes the Peddars Way & Norfolk Coast Path National Trail.

Almost the entire route of the Norfolk Coast Path runs through the Norfolk Coast Area of Outstanding Natural Beauty. It is a relatively modern route and combines the peace and quiet, and at times remoteness, of nature, with the warmth of village life.

The section close to/passing through the Glaven catchment area lets you skirt around salt marshes and wander along shingle beaches and beside freshwater marshes teeming with wildlife.

Source: http://www.nationaltrail.co.uk/PeddarsWay/
www.norfolk.gov.uk/Leisure_and_Culture/Norfolk_Trails/Norfolk_Coast_Path/index.htm

Holt Country Park



Map showing the location of Holt Country Park within the Glaven Catchment boundary

Situated close to the town of Holt, Holt Country Park consists of almost 100 acres of tranquil woodland comprising of over 30 tree species – mainly Scots Pine, Oak and Silver Birch. The site has an interesting history, including at one time being used for horseracing. However today it offers peaceful walks along waymarked trails that are suitable for wheelchairs and pushchairs.

Holt Country Park is home to a wealth of wildlife – from orchids, butterflies and dragonflies in summer to beautiful snowdrops in winter. The bird list for the site contains almost 100 species.

The park is open every day. There is plenty of parking for a small fee, a visitor centre with toilets, a play area, totem pole and a viewing tower. There are also lots of events organised throughout the year.

Sources: www.northnorfolk.org/community/2261.asp; www.northnorfolk.org/files/Holt_Country_Park_Leaflet.pdf www.norfolkcoastaonb.org.uk/mediaps/pdfuploads/pd002039.pdf

GETTING INVOLVED

If you want to do more than simply get outside and explore the Glaven catchment area, there are ways that you can become more involved, such as by joining a community conservation group, or recording the wildlife you encounter and make a positive contribution to species and habitat conservation.

The River Glaven Conservation Group

The River Glaven Conservation Group (RGCG) was formed in 1999 as a bottom-up voluntary organisation. It is made up of local people, landowners, fishermen, naturalists and scientists. It also works in "friendly collaboration" with other statutory and conservation bodies, farmers and river restoration professionals. The River Glaven suffered badly for about 30 years from pollution and poor management. However despite this it still provides a mosaic of important wildlife habitats along its length, and over the last 14 years the RGCG has started to reverse some of the damage.

The RGCG website states that the aims of the group are:

- Protect the River Glaven from pollution and degradation.
- Improve river water quality
- Conserve and restore important habitats for wildlife within the river corridor.

As well as the river itself, the RGCG also aim to conserve and restore the habitat of the tributaries, ditches, ponds, fen and wet grassland meadows within the Glaven floodplain.

The first major project undertaken by the group, known as the 'Cinderella Project' received a national award from the Wild Trout Trust in 2007. Read more about this project on the RGCG website: http://www.riverglaven.co.uk/

As well as river restoration, the group has been involved in re-establishing conservation grazing on the river meadows, controlling invasive non-native species both in the river and on the banks, and also in education, having close links to Holt Hall Field Studies Centre and University College London.

Read more about the work of the River Glaven Conservation Group on page 36.

Source: www.riverglaven.co.uk/

The Gunthorpe Stream Project – Ian Shepherd, RGCG

In 2011 the Environment Agency engaged consultant Nigel Holmes to assess some Norfolk chalk rivers and their tributaries for their potential improvements in their ecological condition, and make recommendations for each on how this might be done. The selection of these was based on Environment Agency species surveys. The Gunthorpe Stream (GS), a TRIBUTARY of the River Glaven some 6km in length, was amongst those to be assessed.

Nigel Holmes carried out the GS survey on the 31st January 2012, accompanied by River Glaven Conservation Group (RGCG) volunteers Carl Sayer and Ian Shepherd. Permission was obtained from the four major landowners concerned to walk their land to carry out this exercise. Nigel, with the aid of camera, maps and recorded notes and comments, gathered the basic information he required in our six hour walk. Shortly after the survey walk Nigel provided a report for the Agency, providing both a detailed record of the existing character and an information base from which to plan rehabilitation measures.

This project provided the RGCG an insight into the way, with sufficient voluntary labour, we could carry out small-scale, low cost measures which could offer valuable improvements in in-stream habitat. It required simple 'gardening tools' and the use of materials at hand, with no transport required, and no cost. And much of this was done in areas where the use of heavy plant machinery was impractical or impossible – it was manual labour or nothing. It also offered a vehicle both to train existing volunteers and to show potential new recruits how they could contribute to the enhancement of the smaller main rivers, or the tributaries of the larger main rivers. We invited Nigel to speak at our AGM, in the redundant Brinton Church, and local residents were invited to attend the talk as well as RGCG members.

Following the AGM we set about obtaining a licence of consent from the relevant authority to carry out a programme of work. Much of what we wanted to do was literally an 'educated' re-arrangement of the materials in the bed of the stream, and would most likely not have required a formal approval. However we decided to submit the whole proposed programme to present the overall picture of the works to be done, and discussed this with the landowners concerned before the formal submission.

The programme of work was planned for two years or so. A number of factors determined the detail, such as the existing substrate and flow rate of the stream at the chosen location, and for some measures the immediate vicinity of materials, in particular wood. Also of course that there could be no disturbance or harm to any protected species, and the absence of any increased risk of flood risk to property.

The first major piece of improvement work was carried out on 12th April 2013 on some 200 yards of the GS, and 11 separate small scale measures put in place of eight volunteers and with the advice and guidance of Nigel Holmes. The work that was done, the relationship between the technique used and the choice location and the effects sought, are recorded in an illustrated three page manual on the RGCG web site. Since then, from the knowledge and practical experience obtained, further similar work has been carried out on other parts of the stream.

Natural Surroundings – Andrew Cannon

Natural Surroundings, known to many as 'The Wildflower Centre' is a hidden gem of a nature reserve tucked away on the Bayfield Estate near Glandford in the magical Glaven Valley. The rolling glacial landscape of the river valley is quite unlike most visitors' expectations of Norfolk with woodland, lakes and what passes in these parts for hills; this diversity is mirrored in the reserve which packs an extraordinary variety of habitats into its mere eight acres. Nonetheless in recent years lack of management has badly compromised its biodiversity value and for the past three years new owners have been working to restore some of the most important areas.

The primary management objective is to restore and improve botanical diversity, mainly by cutting and grazing but also by more sympathetic maintenance generally and, in the beautiful but neglected display gardens, deliberate re-planting of native and wildlife-friendly species. *Natural Surroundings* is an unusual nature reserve in that it is not an externally funded 'charity' managed from a distance but a small business with a sustainable ethos owned by and employing local residents, very much an integral part of its rural community. Conserving wildlife and generating a modest rent for the estate, it aims to reconcile and align three sets of interests - landowners, local inhabitants and wildlife - as a case study in how ECOSYSTEM services contribute to an economically viable countryside.

We've been very lucky that a number of volunteers have bought into this idea and have made a great contribution to the restoration of the reserve, not just through the usual 'grunt work' – mainly fen cutting and raking – but by taking the initiative to develop and maintain small projects such as bird hides and a butterfly garden. Already the work of volunteers has brought dragonflies back to restored ponds and fen drains and orchids back to properly managed wet meadows. Countless visitors have seen how the restored wild gardens full of native plants can be beautiful as well as biodiverse. Volunteer recorders have ringed birds, identified hundreds of moths, found rare beetles and scarce fungi.

We hope with the continued support of the local community and friends near and far to ensure the further development and sustainable future of this unusual and interesting reserve, which you can read more about at www.naturalsurroundings.info.

Visitor Centre © Andrew Cannon


Fen raking © Andrew Cannon

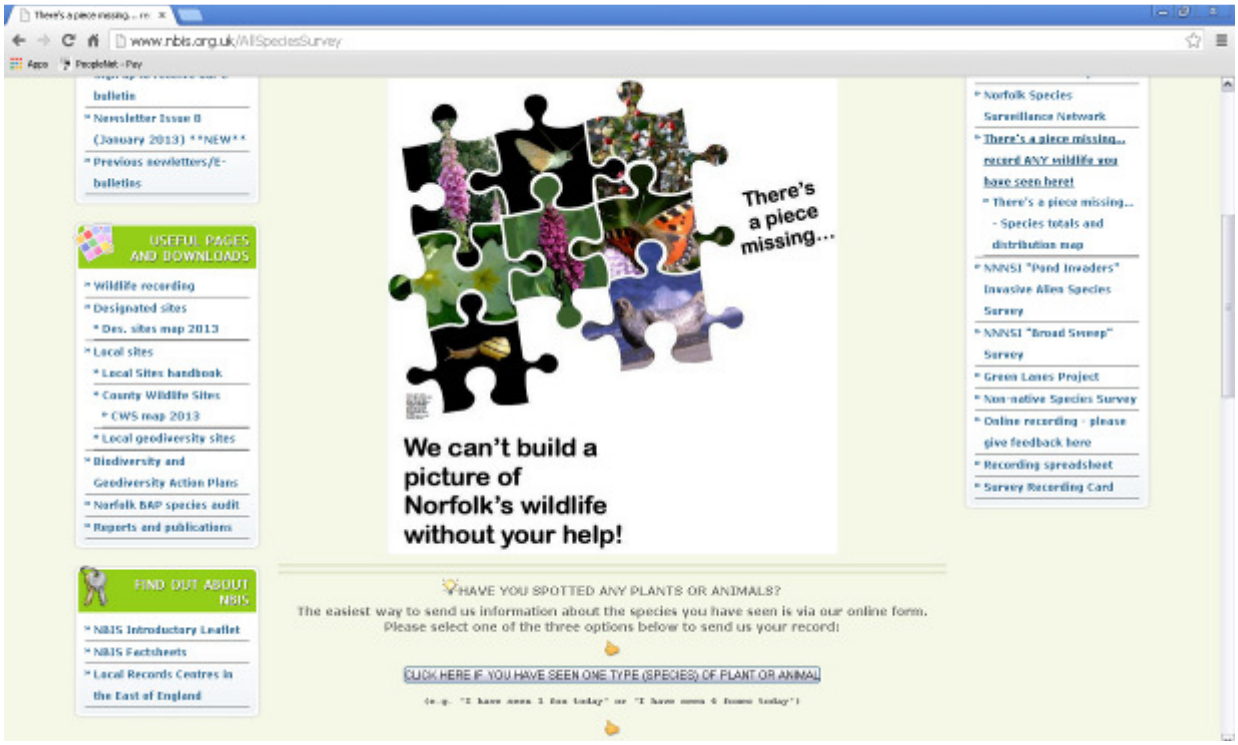
Species Recording

Norfolk Biodiversity Information Service (NBIS) collects, collates, manages and disseminates information on species, habitats, GEODIVERSITY and protected sites in Norfolk. The majority of species records come from volunteer recorders, who regularly send in details of the wildlife they have seen.

If you want to record wildlife in the Glaven catchment and be part of improving our understanding of the catchment's environment, helping to protect it, you need to record the 'four Ws' – WHAT you saw, WHERE you saw it, WHEN you saw it and WHO you are.

If you're not 100% sure of what species it is, then please don't record it. Or send a photo to NBIS so they can check the identification.

You can email your records to nbis@norfolk.gov.uk or why not use our online recording form at http://www.nbis.org.uk/AllSpeciesSurvey



THE COUNTRYSIDE CODE

The countryside code helps members of the public to respect, protect and enjoy the countryside. It is mostly common sense, and by following it we can ensure that visiting the countryside is an enjoyable experience for everyone.

Be safe, plan ahead and follow any signs:

Even if you're just venturing out locally it is best to get the latest information on where you can and can't go. For example some areas of open land may be closed while work is carried out or during breeding seasons. Follow advice and local signs. Be prepared for the unexpected!

Leave gates and property as you find them:

Respect the working life of the countryside. Our actions can have an effect on people's livelihoods, our heritage and the safety and welfare of animals and ourselves.

Protect plants and animals, and take your litter home:

We have a responsibility to protect our countryside both now and for future generations. Make sure you don't harm animals, birds, plants or trees.

Keep dogs under close control:

The countryside is a great place to exercise dogs. However it is every owner's duty to ensure that their dog is not a danger or nuisance to farm animals, wildlife or other people.

Consider other people:

Showing consideration and respect for other people who live, work or use the countryside for recreation helps to make it a pleasant environment for everyone.

GLOSSARY

ANGLIAN GLACIATION – An ice age period which occurred between 450,000 and 300,000 years ago.

BARROW CEMETERY – A group of barrows (large mounds of earth or stones placed over a burial site) clustered together and representing the gradual build up of burials and their associated monuments and structures over a period of time.

BRYOPHYTES – Mosses and liverworts.

CARR WOODLAND – A waterlogged wooded habitat.

EC HABITATS DIRECTIVE – A European Union Directive adopted in 1992 aiming to protect 220 habitats and around 1000 species listed in the directive's Annexes. Led to the setting up of a network of Special Areas of Conservation.

ECOSYSTEM – A biological environment consisting of all the organisms living in a particular area, as well as the non-living components with which the organisms interact (such as air, soil, water and sunlight).

ELVERS – Young eels that are migrating upstream in freshwater.

FLUVIAL GEOMORPHOLOGIST – Someone who studies rivers, both in their natural setting and how they respond to human-induced changes.

GEODIVERSITY – The variety of rocks, minerals, fossils, soils and landforms, and the natural processes that formed them.

GLACIAL OUTWASH PLAIN – Large areas of glacial sediment deposited by streams of meltwater.

INVERTEBRATES – Animals without a backbone.

KAME – A pile of sand, gravel and till that has accumulated in a depression on a retreating glacier, and is then deposited as a mound when the ice melts.

MACROINVERTEBRATES – INVERTEBRATES that are large enough to be seen with the naked eye.

MACROPHYTES – Plants that are large enough to be seen with the naked eye. Generally refers to an aquatic plant.

MEANDERS – Naturally forming bends in a winding watercourse or river.

OUTWASHED GRAVEL – Deposits of gravel carried by running water from the melting ice of a glacier.

RAMSAR CONVENTION – An international treaty for the conservation and sustainable use of wetlands.

RIFFLES – A rocky or shallow part of a stream or river where the water flows brokenly.

RING DITCH – A circular trench cut into bedrock. Usually identified through aerial photography as soil marks or cropmarks.

SALMONID FISH – Family of fish including salmon and trout.

SCHEDULED MONUMENT – A nationally important archaeological site or historic building, given protection against unauthorised change.

TRIBUTARY – A river or stream flowing into a larger river or lake.

VALLEY MIRE – Area of water-logged deep peat at the bottom of a valley.

WATER FRAMEWORK DIRECTIVE – A European Union directive which commits European Union member states to achieve good qualitative and quantitative status of all water bodies by 2015.

USEFUL WEB LINKS

General

Norfolk Biodiversity Information Service: www.nbis.org.uk

Norfolk Biodiversity Partnership: www.norfolkbiodiversity.org

Norfolk Non-native Species Initiative: http://www.norfolkbiodiversity.org/nonnativespecies/

Norfolk Wildlife Trust: http://www.norfolkwildlifetrust.org.uk/

GEODIVERSITY

Chalk rivers:
www.norfolkriverstrust.org
www.riverglaven.co.uk/about-the-river-glaven
www.wildlifetrusts.org/wildlife/habitats/chalk-streams

Blakeney Esker: www.bgs.ac.uk/blakeney

Geological Landscapes of the Norfolk Coast:
http://www.norfolkcoastaonb.org.uk/pages/pspage.php?PageID=568

Important Sites

Protected sites:
http://www.naturalengland.org.uk/ourwork/conservation/designatedareas/default.aspx

Norfolk Coast AONB: www.norfolkcoastaonb.org.uk

Natural England SSSIs:
http://www.sssi.naturalengland.org.uk/Special/sssi/index.cfm

Habitats and Land-Use

Floodplain Grazing Marsh:
UK Action Plan - http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-07-CoastFloodGrazingMarsh.pdf
Norfolk Action Plan-
http://www.norfolkbiodiversity.org/pdf/SAPsHAPs/HAPs/Floodplain_grazing_marsh_Dec_05.pdf

Wet Woodland: http://jncc.defra.gov.uk/pdf/UKBAP_BAPHabitats-64-WetWoodland.pdf

Ancient Woodland: www.naturalengland.org.uk/Images/standing-advice-ancient-woodland_tcm6-32633.pdf

Heathland & Dry Acid Grassland:

http://www.norfolkbiodiversity.org/pdf/SAPsHAPs/HAPs/lowland%20heathland%20plan%20-%20FINAL%2017%20Nov%202011.pdf
Ponds: Sayer C, Shilland E, Greaves H, Dawson B, Patmore I, Emson D, Alderton E, Robinson P, Andrews K, Axmacher J & Wiik E (2013). *Managing Britain's Ponds – conservation lessons from a Norfolk farm.* British Wildlife **25**: 21-28

Species

Crucian carp:
Sayer CD, Copp GH, Emson D, Godard MJ, Zieba G & Wesley KJ (2011). *Towards the conservation of crucian carp Carassius carassius: understanding the extent and causes of decline within part of its native English range*. Journal of Fish Biology **79**: 1608-1624.

Copp GH & Sayer CD (2010). Norfolk Biodiversity Action Plan. Crucian Carp (*Carassius carassius*) Norfolk Biodiversity Partnership.

Otters:
Almeida D, Copp GH, Masson L, Miranda R, Murai M & Sayer CD (2012). *Changes in the diet of a recovering Eurasian otter population between the 1970s and 2010.* Aquatic Conservation: Marine and Freshwater Ecosystems **22**: 26-35.

Sayer C, Almeida D, Copp G, Sayer D, Linford T, Cornwall C & Murai M (2011) *What do otters eat in the Glaven Catchment?* River Glaven Conservation Group Newsletter Spring 2011.

Historic Environment

Historic Churches:
http://www.heritage.norfolk.gov.uk/

Watermills
http://www.norfolkmills.co.uk/

Burgh Parva & St Mary's Church:
http://www.heritage.norfolk.gov.uk/

Weybourne Camp:
http://www.heritage.norfolk.gov.uk/

Environmental Quality

Water Quality: www.environment-agency.gov.uk/research/planning/124725.aspx

Getting Out in the Glaven catchment

Norfolk Coast Path:
http://www.nationaltrail.co.uk/PeddarsWay/
www.norfolk.gov.uk/Leisure_and_Culture/Norfolk_Trails/Norfolk_Coast_Path/index.htm

Holt Country Park:

www.northnorfolk.org/community/2261.asp
www.northnorfolk.org/files/Holt_Country_Park_Leaflet.pdf
www.norfolkcoastaonb.org.uk/mediaps/pdfuploads/pd002039.pdf

Getting Involved in the Glaven catchment

Natural Surroundings: www.naturalsurroundings.info

River Glaven Conservation Group: http://www.riverglaven.co.uk/

NBIS Online Recording: http://www.nbis.org.uk/AllSpeciesSurvey