



Newsletter

Spring 2016

The AGM and the Eel Project



The Eel Project is now half-way through its two years as an HLF funded pilot scheme in the Glaven catchment. As part of this the Norfolk Coast Project and the Norfolk Rivers Trust are running a programme of events over the coming months to further their engagement with local communities. So this year the RGCG will break with our thirteen year tradition of holding our AGM in May or June on a Saturday afternoon, and instead link into one of these events.

Our AGM will be held at 6.30 pm at Blakeney Village Hall on **Thursday 11th August**, and completed in good time for the public event. This starts at 7.30 pm, and is a film and talk: The River Glaven – a Norfolk Chalk Stream, and its Eels. Please make a note of this in your diaries now; as always this Spring Newsletter is the only notification of the AGM.

As you will see from this Newsletter, and that of Autumn 2015, the Eel Project is making good progress. In

this edition we have an article on the historic importance of the eel as food; Murray Thompson of UCL on a standard, evidence based approach for the survey of invertebrates; and a study on the Stiffkey on eel behaviour which we hope will now be extended to the Glaven. The latter has been done by Adam Piper of the Zoological Society of London, and has relevance on how the eel faces barriers. The last edition carried an article by Alan Walker of Cefas, a study which aims to get a better understanding of the eel life cycle, and in particular the return Autumn migration. There was also a report from Willie Brownlow at Glandford Mill on the Spring run of the incoming elvers.

The project has been helped by some earlier activities, in particular the installation of a fish pass at Glandford Mill in 2012. However the free passage of migratory fish, eel and sea trout, is seen to be the remaining most important matter to be resolved,

and in particular what happens at the Cley tidal sluice. Meanwhile the eel has benefitted, along with other fish and wildlife, from past work on habitat restoration and creation in the Glaven catchment, and this type of activity continues.

All this good news however is tempered by some bad news, with a fish kill seen on 5th January at Natural Surroundings, but coming from the upstream area of Bayfield New River. Last June this stretch was shown to be performing brilliantly in the range and amount of species present; and just 10 months after the project was completed. The most sensitive and affected fish was the brown trout, and a survey in late March indicated there had been a severe decline in trout on the New River stretch. It is difficult now to identify with certainty the cause or causes. However there is much we can and will learn from this incident, see page 10 for an article on various types of pollution.

The Great Plenty: a History of Eels as Food

Dr Ian Shepherd



Illustration by Kate Dougan/NCP

Research carried out in Japan suggests that eels evolved between sixty and a hundred million years ago, and that the ancestral species arose in the western Pacific, near present day Indonesia. Perhaps thirty to fifty million years ago the primal species split into two groups. One group moved west about twenty-five millions years ago and perhaps divided between an Atlantic contingent, consisting of the European and North American species, and the African and Australasian species. So the eel is an ancient and primitive creature, but not a simple one. Its sensory equipment is both highly complex and still remains only poorly understood. For centuries man speculated on the life cycle of the eel. The extraordinary journey that occupies the first and last stages of its life has never been witnessed by the human eye.

In between the arrival to our shores as an elver, and the return as a mature silver eel to spawn in the Sargasso Sea, an eel may be no further away from us than the nearest piece of water. Were

you minded to look, you could find the European eel anywhere from Iceland, around Scandinavia, through the Baltic, down Western Europe to the northern coast of Africa as far east as the Suez Canal. On the other side of the Atlantic, the American eel extends from Greenland and Labrador to the Gulf of Mexico and Venezuela. These two species start as larvae in different parts of the Sargasso Sea, but travel as larvae and glass eels on different ocean currents

The importance of eels in the diet of man has always lain in their great abundance, in particular in the migration periods; and in their ubiquity in the 20-25 year period in the life cycle that an eel might be found in a river or freshwater pond or lake. Even in winter they might be disturbed in the mud and caught to provide a year round source of fresh meat.

An insight into how our pre-historic ancestors lived has been provided by archaeological finds around the northern end of Lough Neagh in Northern Ireland, which remains the

most abundant wild eel fishery in Europe. There is evidence of some of the earliest known settlements going as far back as nine thousand years ago. The oldest is on the lower Bann, the river which connects Lough Neagh to the sea and acts as a gateway for inner and outer migration. This includes a line of wooden stakes connected by wicker-work; unmistakably a four thousand year old precursor of the sheagh, or fishing weirs, still used today on the Bann to intercept eels. It is likely that these Mesolithic hunters moved up and down between the lough and the sea, occupying and deserting camps according to the dictates of the seasons. Around 3000BCE the first Neolithic farmers arrived in the area and the two groups may have co-existed in passable harmony, the earlier concentrating on the specialised of hunting and fishing, and trading their captures for tools of polished stone and earthenware pots.

In Continental Europe the remains of prehistoric traps – in the form of stakes and woven fences – have been



**Above: Elvers caught on the 4th July at the Glandford Mill monitoring trap.
Right adult Eels, all caught in the electro-fish survey at the Bayfield New River, 29th June 2015.**

found on the Danish coast where the silver eels exit to the North Sea. Pieces of spear made of bone and horn have been found all over Scandinavia and as far east as Poland. In central France, close to one of the main tributaries of the Dordogne, a carved cylinder of stone was found in a cave showing a human, two horses and what appears to be an eel. Thousands of years before Aristotle and his pen of split reed scratched the first observations and speculations about eels on his papyrus sheet, men who lived by water had worked out all they needed to know to lay hold of an elusive but reliable source of food. They knew that through the summer eels fed and could be caught on bait; with the coming of autumn they made their way downriver; and in the winter they hid in the upper layer of mud. They were good to eat, and ever-present; and men have made nets, pots, traps and hooks to catch them.

However as with so much else, it was the Greeks who first found the words to sing the praises of the eel. The curiosity of their intellectuals – most notably Aristotle – about the creature's life cycle clearly reflected an established epicurean enthusiasm. In Aristophanes' *The Archanians*, the hero on hearing that a smuggler had secured for him fifty of the succulent

eels of Lake Copais, bursts forth: '*O my sweetest, my long-awaited desire*'. In another of his plays, a sausage seller shouts: '*Yes, it is with you as with eel-catchers; when the lake is still they do not take anything, but if they stir up the mud, they do; so it is with you when you disturb the state*'.

The first record of eels in the Thames, at 1050, is the payment of a hundred eels a year by the people of Oxford in return for leave to dig a navigation channel on church land. The Domesday Book listed a total of 22 fisheries on the Thames, which – calculated for taxation purposes – produced 14,500 eels a year. The eels were speared, netted, bobbed for, caught in baited traps, and intercepted in V-shaped weirs known as kiddles. For centu-

Eel Life

The European eel spawns in the Sargasso Sea, between Bermuda and Puerto Rico. The larvae drift some 3,700 miles in Atlantic currents and reach our rivers as transparent 'small glass' eels, or if more mature and darker, elvers. After five to 20 years in our freshwater rivers and ponds, eels return to the Sargasso Sea and complete their life cycle.

ries the start of the annual elver run saw Londoners wade in with muslin nets, sieves and buckets. Yet by 1878 Houghton in his *British Freshwater Fishes*, recorded that '*the eel-fayre, once a striking and remarkable sight on the Thames, no longer exists, on account of the filthy water around London*'.

Prior to that we have an early Victorian curate David Badham in his book *Ancient and Modern Fish Tattle*: '*London...steams and teems with eels alive and stewed; turn where you will and 'hot eels' are everywhere smoking away, with many a fragrant condiment at hand to make what is itself palatable yet more savoury For one half-penny a man in a million may fill his stomach with six or seven long pieces and wash then down with a sip of the glutinous liquid they are stewed in*'. Earlier again we have Shakespeare's Fool saying to Lear: '*Cry to it, nuncle, as the cockney did to the eels when she put them in the paste alive; she rapped them o' the coxcombs with a stick and cried "down wantons, down"*'.

Izaak Walton in the first edition of *The Compleat Angler*, published in 1653, wrote: '*It is agreed by most men that the Eel is a most dainty dish. The Romans have her as the Helena of their feasts, and some the queen of palate pleasure*'. Walton cautioned against

overdoing it, quoting Solomon: 'Eat no more than is sufficient, least thou surfeit'. This call for self-restraint is somewhat negated by his favourite recipe, which is more basic than our TV chefs:

'First wash him in water and salt; then pull off his skin below his vent or navel, and not much further: having done that, take out his guts as clean as you can, but wash him not; then give him three or four scotches with a knife; and then put into his belly and those scotches sweet herbs, an anchovy and a little nutmeg grated or cut very small and mixed with good butter and salt; having done this, then pull his skin over him all but his head, which you may cut off, to the end that you may tie his skin above that part where his head grew, and it must be so tied as to keep all his moisture within his skin; and having done this, tie him with tape or packthread to a spit and roast him leisurely, and baste him with water and salt till his skin breaks and then with butter; and having roasted him enough let what was put in his belly, and what he drips, be his sauce'. Although Walton's recipe was ornate and clearly intended for special occasions, the abundance of eels, the length of their season, the ease for which they could be kept alive for lengthy periods, and their range of distribution made them a dietary staple for the English and much of Continental Europe.

The illuminator of Anglo-Saxon ways, the monk Bede of Jarrow, has something to say on eels. He credited Saint Wilfred with having saved the South Saxons from famine in the late seventh century: *'The people had no skill in fish-catching except only for eels...The Bishop's men used the eel nets...and with the help of Divine Grace caught 300 fish'*. It is to Bede that we owe the traditional derivation of an ancient centre of virtue and learning: *'Ely is in the province of the East Angles, a county of about 600 families in the nature of an island enclosed with marshes or with waters, and therefore it takes its name from the great plenty of eels taken in these marshes'*.

The people living in the Fen owed their obeisance to their ecclesiastical overlords in the abbeys and monasteries which had arisen on the few knobs of dry land. There is a roll of their names in one of the early texts, the Coucher Book of Ely: *'Henry son of Osbert de Walpole, Hugh Wade, Henry Dale, Moyses, Roger Fot, John Gubernator.....14,500 eels paid on the first Sunday in Lent'*.

In the Ramesey Cartulary the foundation charter granted in 970 by King Edgar: Alfgar of Hilgand and Hugh of



Roger Grady, retired Eel Catcher from the River Wensum

Wigginhall, altogether *'seven fishermen and their seven assistants and seven little ships'*. The charter mentions among the properties owing dues, the manor of Welles *'which was of profit to the abbey solely on account of its render of eels; 20 fishermen gave 60,000 eels every year for the use of the brethern'*. The monks of Thorney Abbey were similarly well provided for, Bishop Aetholwold having endowed them – at a cost of twenty-one pounds – with the fisheries *'surrounding the villages of Wyllan and Eolum.... And 16,000 eels were captured each year'*. Bishop Aetholwold had as a young man been Dean at Glastonbury, which was the greatest of all religious houses and commanded another eel stronghold, the Somerset Levels. He was a strict Benedictine, and imposed the doctrines, including the powerful interdict against the eating of meat on a number of institutions. This prohibition was less burdensome at Glastonbury than

Telling Tales

One aim of the River Glaven Eel Project is to record stories on the eel that relate to our natural history and cultural aspects. The project is supported by the National Lottery through the Heritage Lottery Fund. If you can tell us anything about eels in the Glaven valley past and present we would love to hear from you. Contact Mark Webster 07843 069 567 markw@norfolk-wildlifetrust.org.uk, website, www.norfolkriverstrust.org/eels-project.

in some other places. As early as 670 the monastery's abbot, was granted by King Cenwalh of Wessex the rights to fishing at Meare on the Brue River. The chief fishermen lived there and organised a regular supply of eels, tench, carp, pike and roach for the monks. For seven hundred years and more Glastonbury reigned supreme among the religious institutions of England, until Thomas Cromwell contrived the execution of its last abbot: *'The Abbot of Glastonbury is to be tried at Glastonbury and also executed there with his complycys.....see the evidence be well sorted and the indictments well drawn'*. Abbot Whiting's head was placed on the abbey's walls; and the quarters of his body were displayed over the gates of Wells, Bath, Ilchester and Bridgwater.

One of the great attractions of the eel was that through the ages when most fish and meat was of necessity preserved in salt, it was readily obtained fresh, if not actually alive - eels can breathe through their skin as well the gills. When Henry III celebrated St Edwards Day in October 1257, it was said that fifteen thousand eels were provided for the feast. The *'great plenty'* was most evident of all where the tidal displacement in an estuary is at its greatest. The first white settlers were amazed at the abundance of fish on the St Lawrence; not just eels, but salmon, sturgeon, shad and alewives. There is archaeological evidence of man five thousand years earlier using this river for seasonal eel fishing. The Severn and the Loire also share the high tidal swing and flow rates which facilitate the migration of elvers and the silver eel.

Weston Longville All Saints Church in Norfolk is famous as the living of James Woodforde, diarist and rector there from 1776 to 1803, spanning the American War of Independence to the Napoleonic Wars, but his entries focus on his interest in food and dining out. He also recorded his keen appreciation of the occasional *'fine string of eels from his local miller, and would have them stewed in milk or rolled in seasoned flour and fried in clarified butter'*. The French too revered their eels. A cookery book of the seventeenth century, *Le Cuisinier Francais*, gives a bewildering range of recipes, including eel stuffed with whiting and mushrooms and braised in brandy and white wine, eel served with fish veloutee and crayfish coulis, and eel sliced and larded with anchovy fillets. This Continental interest persists to the present day. In traditional Italian households the ritual of Christmas Eve includes a dish of roasted eel. The

Dutch adore them smoked. The Germans love big eels, stewed or smoked. The Danes have an ancient habit of feeding them, as do the Swedes, the Finns, the Belgians and the Swiss. The Spanish and Portuguese are enthusiastic about eels fried, roasted, grilled, broiled, boiled, steamed, stewed, smoked and pickled. Other nations were and are more prosaic: witness a ditty quoted in the official History of the Town of Windham in New Hampshire, published in 1883:

*From the eels they formed their food
in chief*

*And eels were called the Derryfield
beef*

*It was often said that their only care
And their only wish and their only
prayer*

*For the present world and the world
to come*

Was a string of eels and a jug of rum

The United States developed into a city based society, and the habit of eating freshwater fish withered. With the development of the rail network, almost all the population centres located within the eel's distribution range became accessible to supplies of fish from the sea, which was regarded as being tastier and generally more appealing.

The same thing had happened already in England. The railway lines reached every corner of the land, enabling the ports to dispatch fresh sea fish anywhere and everywhere. In the course of the nineteenth century the middle classes abruptly forsook the mundane flavours of carp, tench, pike and eels, and they have never returned to them. Within a couple of generations the economic and social chains which had anchored age-old traditions in their particular regions began to give way, and with them the eel-catcher. The last British cookbook to take an interest in eels was the 1934 edition of Mrs Beaton which included recipes for eel soup, jellied eel, boiled eel, stewed eel and fried eel.

Only in Japan does the appetite for eels remain at all levels of society, and the eel occupies a place of enormous importance in the complex relationship with their food. Long ago this had out-stripped the supply of their native wild eel, and they became pioneers in the farming of eels. By the 1960's, elvers from the Severn were shipped by air freight to Japan to meet this demand. It is estimated (2002 figures) that more than a hundred thousand tons of eel are consumed annually in Japan. This was ten times as much as all the other eel countries in the world put together.

Ian Shepherd writes:

The material for this article is drawn from across *The Book of Eels* by Tom Fort, and published by Harper Collins in 2003 in paperback at 332 pages. The publisher rightly says the book 'is a fascinating, witty account of Tom Fort's obsession with the eel, its mysterious origins and the myths surrounding it, his journeying to discover the eel in all its habitats, and the people he meets in his pursuit'. The book also received praise from a range of newspapers and journals. The best of which is perhaps from the *New Scientist*: 'A fascinating, beautifully written and deeply peculiar book. It is more than a scientific detective story, it is a rich concoction of different genres, part social history and part autobiography, seasoned with culinary tips. But this book is also a lament for a vanishing way of life'.

Do not think of the word 'peculiar' as meaning 'odd'. Think along the lines of 'Unlike others, singular'; or 'of separate constitution, or existence'. The breadth of research and reading is astonishing. This is a labour of love for a creature that does not have a loveable and cuddly public image; but for millennia was a key source of food for man.

The Lament of a Fens Eel Catcher

Early this year the national press and EDP picked up from Twitter a story; Britain's last eel catcher will bring a 3,000 year old tradition to an end. The man was Peter Carter, a fifty year old from West Norfolk living in Outwell. He was quoted as saying 'I can't find a successor or live on empty pockets. He traces his family fishing activities back to at least 1475. It breaks his heart that his last wicker eel hive and grigs have been lifted from the river, that he will not be making any more. "I've found employment elsewhere but still working around the waters". That said he was still trying to come to terms with the momentous decision he had taken as he'd always identified spiritually with thousands of other fishermen down the ages. "I feel I have let down all eel men of the past – over 3,000 years of Fen life have finally gone". "Let the eels swim free as I lift my punting pole for the last time".

His letter struck a chord with well-wishers across East Anglian wetlands. Fenland author Deborah Curtis said: "This is very sad – it is the passing of a great Fenland tradition. Peter was the last licenced eel catcher and fisherman. He also knew the Fenland waters inside out. Peter would keep an eye on the waters and see changes happening around him. He was a

great spokesman to comment on local environment issue in the Fens".

Mr Carter featured in the EDP in July 2014 when bumper numbers of elvers had returned to the Fens, sparking new hope for the industry. However Cliff Carson, environmental officer for the Middle Level waters in the Fens said they had suffered a subsequent collapse. In 2014, it was a great year for us with the elvers. Numbers are down from this peak, but are not as disastrous as previous years. Speaking in 2010, Peter said he had opened the doors of his Outwell workshop so that people could see him making eel traps, willow work, nets and wood carvings. He said then "Eel catching is getting worse and worse. The eel stocks are getting lower and I'm not getting the amount of money I used to". He said he was not the only generation to have to adapt to change in the times and his relatives had been peat cutters and wildfowlers, as well as eel fishermen. I never used a clock. "I start when I start and I finish when I finish".

Find out all about Eels

Saturday 21 May is World Fish Migration Day, and at Cley Marshes there is a celebration of the lives of eels, fish and whales which can travel huge distances to reach our coast: 11am to 4 pm. Tuesday 9 August, Bodham Village Hall at 7.30 pm there is an illustrated talk, Enigmatic, Charismatic and Mysterious – the Curious Life of an Eel. Thursday 11 August there is a film and talk about eels: A Norfolk Chalk Stream and its Eels, at Blakeney Village Hall, starting at 7.30 pm. Refreshments are provided at both these August talks. On Thursday 15 September a third film on eels is showing, at the Church of St Andrew in Holt: The Last of the Great Eastern Eel Catchers, starting at 7.30 pm. On Saturday 17 September there are two walks along the River Glaven. Meet 10am outside the Cley Spy shop in Glandford for a waterside walk with a café stop on route and another for lunch at the end. At 2 pm outside Holt Country Park visitor centre there is a walk: Discovering the River Glaven and its tributaries, finishing at 4.30 pm. For more information on these events call Mark Webster: 07843 0069567; or at www.norfolkriver-trust.org/eels-project. There is no charge for these events, delivered by the Norfolk Rivers Trust for the Norfolk Coast Partnership's Heritage Lottery Fund Project.

Investigating Eel Migration on the River Stiffkey

Dr Adam Piper, Zoological Society of London

Dr Ros Wright, Environment Agency

European eel stocks have suffered a substantial decline in recent times with estimated recruitment reduced to 4 to 12% of 1980s levels in many rivers. This prompted its current designation on the IUCN red list as 'critically endangered' and led to the passing of European legislation in 2007 to establish measures for the recovery of the stock. In England and Wales, this legislation is applied through the Eels (England and Wales) Regulations 2009 which require that passage be provided at existing structures deemed to present a significant obstruction (high priority barriers), and that no new river structures are built or existing structures modified without measures put in place to protect eel and ensure they can migrate unhindered between habitats.

The European eel is a facultative catadromous species which means that it typically (though not always) requires access to both marine and freshwater habitats to complete its lifecycle. From spawning grounds thought to be in the Sargasso Sea, larval eels travel across the Atlantic, arriving on our shores as glass eels which migrate into freshwaters for their main growth phase as yellow eels. Not all juveniles migrate up rivers, some will remain in the estuary for part or all of their continental growth phase. After 3 to 20+ years, depending on the sex of the eel, growth and environmental conditions, eels metamorphose into the 'silver eel' lifestage and start their 5000-6000 km migration back to the Sargasso sea.

Due to this double migration (upstream as juveniles and downstream as adults), river structures such as weirs, dams and hydropower facilities which preclude access to suitable habitats are thought to be a contributing factor in the population decline. Also, due to their elongated body shape and relatively poor swimming abilities, eels are particularly vulnerable



to damage and mortality at screens, water pumps and turbines.

The EA, in collaboration with structure owners and conservation NGOs, is undertaking a programme of works to install eel passes at structures which severely hinder or prevent eel migration. This work is being tackled in stages with high priority and often larger structures being addressed first. Beyond this, it is also important to understand the impacts of smaller features such as weirs, ramps, culverts and road bridges on fish populations which are often overlooked because they are considered not to pose a problem, though they are 2-4 orders of magnitude more numerous than large structures.

The UK has a network of over 1500 active flow gauging stations (FGS) for the purposes of hydrometric monitoring, with the majority owned and operated by the Environment Agency. FGS designs vary greatly but most

comprise some form of weir, typically creating a head drop, located within an engineered channel. Water levels upstream, and in some cases downstream, are recorded at fixed intervals for various applications including flood forecasting by providing near real-time determination of channel discharge through the structure.

A project being conducted by the EA on the River Stiffkey aims to investigate the impacts of flow gauging weirs on eel movements. The Stiffkey, which has two principal flow gauging structures and fairly good eel abundances, presented an ideal study river and a telemetry study was set-up in 2011. PIT (Passive Integrated transponder) telemetry stations that record when tagged fish swim through or over an antenna loop were constructed both up- and downstream of the gauging weirs at Little Walsingham and Warham. A third station was set up immediately up- and downstream of the



**Clockwise from opposite page:
Flow gauging weir at Little Walsingham, River Stiffkey.**

Electrofishing to capture eels for tagging (photo courtesy of Alan Walker).

Releasing tagged eels downstream of Little Walsingham.

An elver marked with elastomer to enable identification.

tidal sluice gates with the assistance of Buxton Conservation to monitor eels moving between freshwater and the estuary. So far, over 800 eels (142 to 572 mm length) have been captured by electrofishing below key river structures, implanted with a PIT tag

and released back into the river. The PIT tags comprise a small transponder encased in a glass capsule (either 12 mm or 23 mm long) and provide each fish with its own unique identification number. Unlike many other tag types, the lifetime of a PIT tag is unlimited because they do not have a built-in battery that would run out after a certain duration, so they offer potential to study the population over many years, giving a long-term dataset that can be used to better understand year to year variation in movement patterns, barrier impacts, and ultimately escapement rate to the sea of adult eels. Juvenile eels that are too small to be fitted with a tag are marked with elastomer, a coloured non-toxic polymer which allows us to determine passage success for even the smallest size classes captured.

In addition to tracking fish movements at the telemetry stations, environmental conditions such as river discharge and water temperature are

logged throughout enabling fish movements to be analysed in relation to the concurrent environmental conditions. Metrics such as passage efficiency at each structure (i.e. how many times an eel approaches a structure Vs. successful passage), seasonal activity patterns and escapement are quantified to build up a detailed picture of eel movements. This information is highlighting the conditions that hinder free eel passage/movement and is already helping us to design more eel friendly structures and eel-specific passes.

Findings so far indicate that both the FGS investigated are passable to eels of the size classes tagged, however there was evidence of barrier effect and delay of newly immigrating juvenile eels. The peak period of juvenile eel immigration into east Anglian rivers is typically between May to August as water temperatures increase. This is often followed by a second by a second pulse of the larger elvers and yellow eels during August and September. In the River Stiffkey it's been observed that during these warmer, generally low flow periods, upstream migration peaks were associated with rainfall events which induced short pulses of high river flow. High flow events can render natural in-river structures less of a barrier to fish migration by reducing the head drop (effectively the difference in distance between the up- and downstream water levels). Accordingly, it has long been recognised that increased flow events can be the catalyst to migratory activity for many fish species. However, at FGS the increased flow over the smooth engineered structures causes high velocity and relatively uniform (laminar) flow conditions which we have observed to be challenging for eels. Under these conditions both juveniles and adults were recorded making multiple attempts at the weirs before successful ascent. In the most extreme scenario, one individual made a maximum of seventy-three attempts before passing a small crump weir at Little Walsingham.

We still have a lot to learn about the physical and hydrodynamic conditions that eels are able to pass at river structures, these studies are ongoing with a view to tag more eels in 2016 and build on current findings. It is also hoped that the project can expand into neighbouring river catchments such as the Glaven which is also considered to have a number of challenging barriers to eel passage.

For further information, contact Dr Adam Piper at adam.piper@ioz.ac.uk

Developing the Evidence Base for Restoration, Local Volunteer Role

Murray S A Thompson, University College London

Streams and rivers integrate the landscape by connecting headwaters with our countryside, settlements, industries and the sea. Because of this they have in the past been grossly overexploited and receive much of our pollution – even acting as a conduit for our sewage – and have been canalised, straightened and cleared of woody debris to such an extent that the concept of a natural river is disturbingly unfamiliar. In recent decades vast global investment has been directed towards tackling pollution and restoring habitat in order to recover and conserve these ecosystems. Yet, the success of this investment has been almost exclusively surveyed using techniques designed to assess improvements in water quality. There is good reason for this, since many species are sensitive to pollution, poor water quality dictates the extent to which an ecosystem can recover. However, despite widespread improvements in water quality, ecological recovery has not matched expectations in many cases. This quandary has raised habitat restoration to the fore as a means to further recover biodiversity and ecosystem processes.

Habitat restoration is often aimed at reinstating lost natural features such as floodplains, backwaters, pools, riffles and woody debris, which are key to the conservation of a wide variety of flora and fauna. These can be created using heavy earth moving equipment, but alternative techniques are gaining in popularity, including 'rewilding' whereby areas are left unmanaged, beavers reintroduced or trees felled to replicate natural tree-fall. After all, trees are the original river architects!

Volunteers working in conservation schemes are often involved in such projects. Yet, due to a lack of standardised monitoring, there is little supporting evidence that biodiversity or ecosystems recover as a result. Moreover, there is no suitable citizen science monitoring scheme available for volunteers to assess the ecological impact of their river restorations. This is in spite of the fact that the



Upper: forming meanders in the Bayfield New River. Ian Shepherd
Lower: woody debris restoration on the River Bure at Blickling, 2011. Murray Thompson

Opposite: Murray Thompson (left) and Kate Dougan (right) training volunteers to assess the effectiveness of habitat restoration on the Glaven at Bayfield. Ian Shepherd.

river restoration movement in the UK and abroad is largely driven by grass-

roots, local action groups, or third-sector charities – work on the River Glaven is a prime example of this. Consequently, restoration designs are rarely evidence-based, and their impacts are not evidence-assessed. That's not to say they are not effective, but rather we have very little evidence to support and help refine future restoration efforts.

What's needed is a standardised monitoring technique which can be used to compare the ecological impact



of different restoration techniques and thus develop the science of restoration. With this in mind we have adapted the methods used by the Anglers' Riverfly Monitoring Initiative (text box 1) so that volunteers can assess both changes in water quality and the ecological outcomes of river habitat restoration. The new method employs a habitat survey, uses invertebrate colonisation traps and measures how quickly organisms work together to decompose a standardised resource. We are piloting this approach across the country, with sites on the River Glaven, Stiffkey and further afield

Our aim is to teach volunteers a standardised monitoring protocol so they can evaluate their own river restoration work and compare these results across river catchments, and thus to produce a trained cadre of citizen scientists whom recognise the best methods to recover degraded ecosystems and conserve the biodiversity and improve water quality of rivers across the UK. As data from multiple projects are combined our understanding of the effectiveness of each scheme and river restoration in general will increase. Our ultimate goal is that volunteers working in conservation schemes will then be able to design and monitor better restoration projects as a result.

Get involved – become a River Guardian
Kate Dougan, Norfolk Coast Partnership

The Norfolk Coast Partnership, which manages the Norfolk Coast Area of Outstanding Natural Beauty, works closely with the Norfolk Rivers Trust

Anglers' Riverfly Monitoring Initiative (ARMI) – The Anglers' Riverfly Monitoring Initiative is a citizen-science project focusing on UK rivers [www.riverflies.org] which has more than 100 partner organisations and 2000 active volunteers, monitoring over 1200 sites across the UK. ARMI is coordinated centrally by the Riverfly Partnership and volunteers are supported regionally by an expanding network of 28 Riverfly hubs and local statutory ecologists. Once trained, volunteers sample, count, and identify key invertebrate taxa (e.g. mayfly, caddisfly, stonefly and freshwater shrimp) in order to assess river water quality. If any of these indicator groups are missing or at low abundance this may signal a pollution event. Data collected complements those collected by statutory agencies, but are collected at a much higher frequency across a much greater distribution of sites, which makes it far more likely that pollution events will be detected and traced. ARMI has also been shown to deter would-be polluters.

regarding ongoing river restoration work and helping members of the local communities to get involved.

If you would like to help look after your local river you can become a River Guardian. River Guardians help us to monitor the Rivers Glaven, Babingley, Stiffkey, Gaywood, Hun, Mun, Ingol, Heacham and Burn by reporting

any changes in flow, pollution, presence of non-native species, silt inundation, and other interesting wildlife observations. With this valuable information, the Norfolk Coast Partnership and Norfolk Rivers Trust can determine how healthy the rivers are and if there are any serious concerns. River Guardians can be involved in a variety of ways as there is no requirement for specialist skills or qualifications or commitment to how much time can be contributed.

One thing Guardians do share is a passion for rivers and this was very apparent when we held a restoration monitoring training event at Natural Surroundings, Bayfield back in November 2015. Seven very enthusiastic Guardians attended a two day restoration monitoring course on the Glaven, led by Murray Thompson. It is hoped that with some further guidance from Murray, these Guardians will be able to continue this monitoring for present and future schemes on the Glaven and other chalk streams in the area. By adapting the science in such a way that it becomes accessible to non-specialists, far more information can be collected which in turn will contribute to securing the health of our rivers for future generations to enjoy.

For more information about monitoring restoration contact Murray Thompson (murray.s.thompson@gmail.com), and if you would like to become a River Guardian please contact Kate Dougan (kate.dougan@norfolk.gov.uk).

Our Wildlife – Two Steps Forward and One Step Back? Pollution and the River Glaven

Dr Ian Shepherd

This year marks the 90th anniversary of the founding of the Norfolk Wildlife Trust, an organisation that has done a huge amount to sustain and improve the wildlife and habitats in our county. In spite of that, the chief executive Brendan Joyce, an individual who has done so much to advance the scope and achievements of the NWT, in an article in 2014, felt the need to put this in a wider perspective. He asked how is wildlife in general faring, are our ecological networks healthy and functioning. Do we all realise that our livelihoods and wellbeing depend on a healthy environment and wise use of finite natural resources. The evidence he quoted shows that if we do understand, then collectively we are not doing at all well, in spite of valiant efforts by our wildlife and conservation bodies and many individuals.

The WWF and Zoological Society of London report in 2014 showed that on a global scale matters were much worse than previously thought. Populations of mammals, birds, reptiles, amphibians and fish had declined by an average of 52% in the last forty years. Population of freshwater species had declined in the same period by 76%. By comparison our homo sapiens is doing very well indeed. It managed to double its population from 3 billion in 1960 to 6.8 billion in 2010. It continues at a rate of 82 million year and is set to double to 14 billion by 2070.

Looking at the UK, a landmark “State of Nature” report was published in 2013. This was the work of 25 conservation organisations based on comprehensive studies of 3,148 species; this indicated that over 65% of UK species were in decline, with 10% at risk of extinction. Perhaps for many this is most closely identified by simple observation over decades of the decline in our farmland and migratory birds. Yes there have been many hard-won successes, but overall a very bleak situation.

The RGCG in its own local and modestly resourced way has sought to reverse the trend in our river and catch-



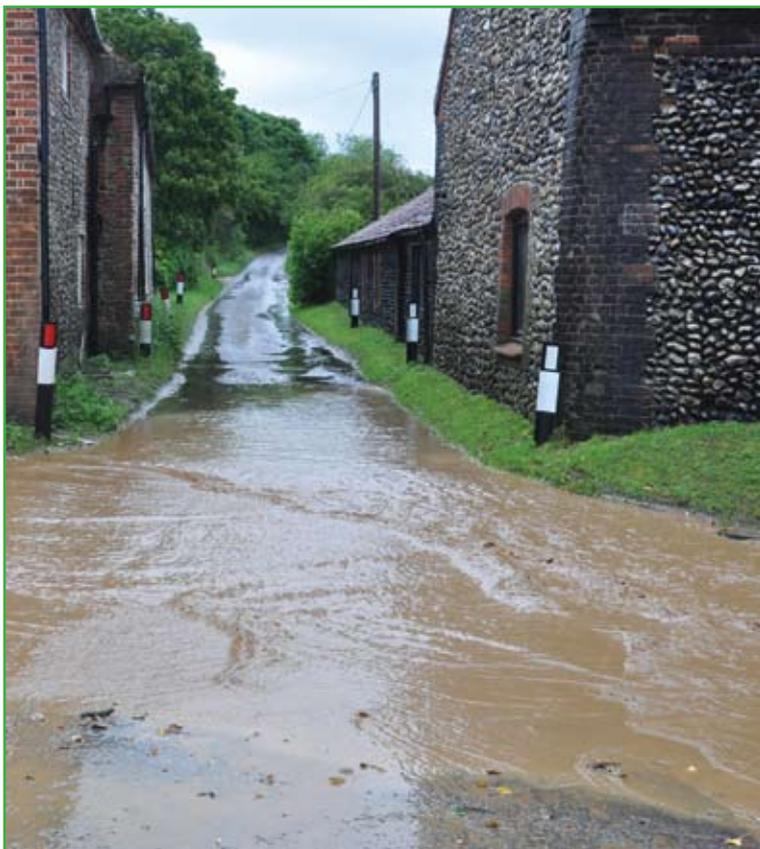
Top: Spout Hills stream is piped under A148 and is joined by the outflow from Holt STW. Then runs across Letheringsett Estate before entering the Glaven.

Lower: River rising in spate on 7th January 2016, 2pm. Looking upstream from Letheringsett Ford. Peaked in period 5-7 hours later to about 20cm above baseline level. River silt laden from arable run-off. 17th April 2015.

ment. With the aid of specialists, and in particular the finance of the 2012-2015 Defra Catchment Restoration, RGCG volunteer efforts supported a big advance in restoring or re-creating habitats. This was a giant step forward, and built on past efforts since our formation in 1999. These included river restoration and meadow re-connection at Little Thornage, re-fencing of these meadows to re-introduce conservation grazing, and an innovative restoration of river and meadow at Hunworth. We had from the beginning an awareness of the biodiversity problems arising from water-borne soil erosion, and the damage that can be inflicted by non-native invasive species, and try to hold the line on these.

There is very pressing need to continue to do all we can with these last two problems, and elicit more external support. Now in addition the first three months of this year have highlighted the need to act more effectively on individual pollution incidents, with three significant events. On the 5th January, a dozen or more dead trout and other species were deposited on 75 m of river bank at Natural Surroundings, in the area of the new observation hut. On the 7th January there was a heavy rain event, which with the river in spate carried much silt. There was a report from the Gunthorpe area of much run-off from a very large sugar beet field; this of course was just one big input to what would have been widespread, particularly in the head waters of the rivers. In mid-March there was oil pollution at High Burgh Beck, almost certainly from the Melton Industrial estate.

Generally in a pollution incident the problem has arisen due to an incident upstream from either a diffuse or point source. In these cases we could only look back to what little observations that were made at the time, which were insufficient to come to any evidenced-based conclusions. We therefore sought some general background information from Tim Jacklin of the Wild Trout to lay the foundations for a more effective and quicker action in future to identify a pollution



Left: Arable run-off from a potato field running down the lane to the river at Letheringsett upstream of the Mill. Right: After less than two hours of heavy rainfall. Run-off stopped soon after the rain, but concentration at one exit from the potato field shows erosion power, cutting deep gully into soil.

Below: Bayfield New River electro-fish survey 29th June 2015, just nine months after the work done; brilliant!

source resulting in damage, and for serious incident report immediately to the Environment Agency on their hotline.

In response to our request Tim said: "Untreated sewage, and other organic pollutants like slurry, silage liquor, liquid fertilisers, are all far worse than silt in causing an acute fish kill. These have the effect of stripping oxygen from the water as it breaks down, and asphyxiating the fish. I think it extremely unlikely that excessive silt from diffuse land sources (arable run-off) would directly kill fish, because the damage mechanism is a mechanical abrasion of the gill structures, and suspended sediment loads have to be massive and prolonged for this to occur. Obviously excessive diffuse silt input causes chronic problems to habitat, fish requirement, etc, of which we are well aware. While silt can cause fish kills it has to be in extremely high loads; possibly a drain, fill, and flush out of a mill pond, which would also strip out oxygen.

Trout are sensitive to low oxygen levels and tend to be affected before other species, such as eels, lamprey and coarse fish. Bullhead are quite sensitive, but may survive better because of their habitat being close to the river bed where a pollution plug may pass



overhead (comparing with trout inhabiting the main water column). The volume/rate of the pollution, extent of mixing in the receiving water, rate of dilution, temperature, etc all have a bearing. Smaller species disappear quickly after a kill (compared to larger fish) so may not have been noticed even if they were affected.

The effect of organic pollutants like untreated sewage is temperature dependent (influencing microbial activity) and are worse as temperature increases. Temperatures are likely to be low in January so that would have mitigated any effect. There could also have been a lag effect, which is where the worst effects are felt some distance downstream of the input; this is because it takes time for microbial activity/oxygen sag to build momentum within the pollution plug, which is continually moving downstream.

Ideally any pollution should be traced back upstream at the time it was spotted – there is chance that an input from something like a road drain could have been responsible causing a local effect. I saw this following a kill on my local brook and I was convinced that the problem stemmed from a poorly managed farm, but when I traced it upstream by kick sampling found it was something workmen had washed down a surface water drain from nearby roadworks.

Key observations on the fish kill were that an electro-fishing survey carried out on the New River late June last year showed a brilliant success for this project with the range and number of species; and another electro-fish survey in mid-March yielded just one trout. Clearly there was a cause for the 5th January event; but such a change in trout count leaves open the possibility of a second and different cause around the 7th January spate.

A heavy rain event has two effects. The impact of arable silt loading on in-river habitats AND settling in mill and other 'on-line' ponds; and secondly pressure on the capacity of a sewage treatment plant to process waste water, sewage and flood water combined. We know that the Holt works have a

(continued overleaf)

capacity issue with input pipework system, as stated when Anglian Water have commented on planning applications for major housing development in Holt. (We also know that the Local Plan running to 2036 will see a lot more housing allocations). We do not know whether the 7th January event resulted in any untreated sewage leaving the plant, and therefore cannot say whether or not this had a role in the overall trout loss at the New River up to the period of the March fish survey.

When silt enters the main river channel it 'drops out' more quickly in slow flow areas, such as the mill pond area (in the case of Letheringsett this stretches from the mill to the ford). Deposition in a mill pond results in a loss of volume capacity, which then results in a reduced milling time – in a small river such as the Glaven, release of water during milling is greater than incoming flow can sustain. The more often there is a loss of mill headwater capacity, the more frequent is the need to for the miller to try and de-silt the pond. Trying to reduce silt in the pond requires a flushing with a draining and re-fill of the pond; and this may be repeated to gain some success. However this procedure can potentially result in an interrupted water flow downstream, with a rush of silty water followed by little flow at all.

It is worth noting that silt from arable sources is associated with nutrients and other agri-chemicals; and that a mal-function at a sewage treatment plant brings with it nutrients and micro-organisms. All sooner or later end up in the estuary which has a Special Area of Conservation designation. Silt in the lower reaches of the estuary also impacts on navigation as well as biodiversity interests.

The oil pollution incident was clearer to identify cause and effect. Jonah Tosney of the Norfolk Rivers Trust saw the oil slick on the High Burgh Beck, followed it upstream, and saw it originated from a road drain by the industrial estate, this on 13th March. He returned late April and did a kick sampling for invertebrates. There was little there at all. A survey of another similar small stream showed it to be jumping and buzzing with life. He

did a video with commentary on both streams and posted on You-Tube. We need more of this activity.

The RGCG will look to develop a code of practice for pollution incidents. Key points will include:

Report an incident and make sure there is a follow-up from those contacted; spread the net to include the RGCG and NRT. The Environment Agency hot-line is 0800 80 70 60 for a serious event. If more than fifty dead fish are counted, including small fish, it makes it a category 1 incident which triggers an EA visit and investigation. Record a small incident for local keeping. It might relate to a recurring problem, or 'out-lying' impact of an incident some distance away.

Take some pictures of any dead fish, recording the date and time. Count the number within the area. Identification is useful, either on the spot, or from photographs. In a major incident you may want to collect some fish and a litre of water, both for potential analysis.

Walk upstream if possible to see if you can track the contaminant input source. This can be fairly obvious trail by visual inspection and sometimes odour; for sewage and silage an ammonia smell amongst the rest; silt levels and water changing from mucky to clean; oil spills as a surface slick, and adhering to bank-side vegetation and smell.



A new and exciting catch in the lower Glaven was a Lamprey about 1 ft long; see picture by Josh Jaggard. This is far bigger than the brook lamprey we are familiar with in the river, and there is some discussion whether they are possibly the same species but different due to sea to river barriers. Like the eel and brown/sea trout, they are also perhaps a migratory species hindered by barriers, in our case Cley tidal sluice. Bear this in mind on 21st May, an international day for migratory fish!

Robin Combe has reported (13th April) on his trapping of the invasive non-native signal crayfish, and the reduction in ponds at Lawn Farm and Watering Lane, a heroic effort lasting four years so far. He says after 8 weeks continuous trapping in Lawn Farm I have withdrawn all 18 traps. I caught a total of 5 signal (4 females all berried and 1 male), all small mature, nothing bigger than 35mm. During that time I have also caught 1x17mm signal from the Watering Lane drop trap. I shall ask for landowner permission to return late summer and continue to monitor the drop trap. Not for a single moment would I claim to have eliminated the signals, but I think I have reduced the population hugely. With the new presence of pike, perch and eels, the signal population will not balloon so quickly again. The grand total over the 4 years of signal crayfish removed is a little over 22,000; that includes 1,200 from Watering Lane. I have all the necessary licences!

Robin is working with Holt Hall and the Holt Youth Project on a scheme at the north end of Bayfield Lake. This is to give less advantaged youngster the opportunity to become interested in angling, and with our countryside and wildlife. They will be mentored by experienced local anglers, and the scheme is now near to going ahead.

News in Brief

RGCG now have a Twitter account in seeking a wider audience, including young people. You can follow us there as well as the blog on our web site. The committee has agreed a new logo – to be revealed at our AGM – which will be common to internet use and print Newsletter. After a committee discussion on a draft communications strategy the design selected is one that is simple and clear in conveying what we do. The communications strategy discussion also provided some points for our activities strategy which we review on a four year cycle, and due later this year.

We aim to work in friendly collaboration with landowners and farmers, conservation organisations and relevant public bodies.

River Glaven Conservation Group

Henry Crawley Chairman 01263 713306

Ian Shepherd Secretary 01263 7113370

Anne Rolfe Treasurer & Membership Secretary

Web site www.riverglaven.co.uk