



The Broads is one of Europe's finest and most important wetlands for nature conservation. It is essentially a freshwater system, becoming more brackish towards the coast. Rivers and broads, fens and carr (alder/willow) woodland, grazing marshes and estuaries, each with their own distinctive characteristics, host a wealth of plants and animals, some of which are unique to the Broads. The distribution of the main open water and terrestrial habitats is shown in **Map 6** (Location and condition of permanent water bodies within the Broads page 56) and **Map 7** (Distribution of fen, woodland and grazing marsh in the Broads page 57).

The high conservation value of the Broads is borne out by its many sites designated for nature conservation. These include 28 Sites of Special Scientific Interest (SSSIs), which cover about 24% (7,166 ha) of the executive area. Only 58% of these sites are currently recovering or in favourable condition. One-third (2,159 ha) of SSSIs are also designated as National Nature Reserves (NNRs) (**Map 8: Network of SSSIs and NNRs within the Broads** page 58). Virtually the entire SSSI network (7,115 ha) is designated as internationally important for nature conservation under the European Habitats and Birds directives, and the Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (**Map 9: Network of SSSIs within the Broads that is also of European importance** page 59). Positive management action for species and habitats of most concern is being implemented through Biodiversity Action Plans, which locally bring together a broad spectrum of partner organisations to deliver measurable outcomes.

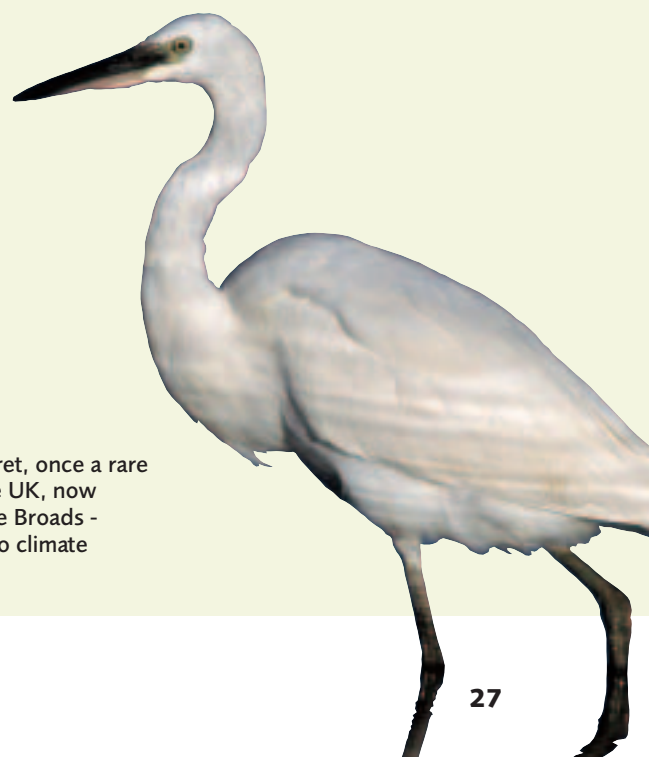
The Broads is a fragile wetland whose habitats were maintained for centuries through traditional rural economies that have all but disappeared. Changes in land use in response to an increasingly arable-based agricultural economy, combined with declining water quality due to nutrient enrichment from fertilisers and sewage, led to severe degradation and loss of habitats in the 20th century. Active management intervention remains crucial to maintaining and restoring these habitats, particularly the rivers and broads, fens, grazing marshes and associated dykes with their aquatic communities. Opportunities to change towards more naturally functioning systems should also be explored where they are likely to be more sustainable and deliver benefits for biodiversity that are currently not enjoyed within managed systems.

Plant and animal communities are also changing in response to a variety of pressures. These range from nutrient enrichment and pollution of rivers and broads to habitat fragmentation and rising sea levels. While it may

not always be possible or appropriate to reverse or even halt such changes, they need to be managed so that these communities and their constituent species have time to adapt and in some conditions colonise new areas. That said, much of the nature conservation effort in the Broads is focused on restoring the rivers, broads, fens and drained marshes to good ecological status. Deciding on where future habitat restoration and creation would be appropriate or where adaptive measures are a more appropriate way forward will be informed by the long-term vision for the Broads' landscape, considered in Chapter 4.

Water

An adequate supply of good quality water is fundamental to the proper functioning of the Broads as a wetland system. The ecological status of water bodies within the Broads is dependent upon the quality and quantity of water entering the catchment from both ground and surface water sources. Thus, water management and land use practices operating in the catchment, most of which lies outside the Authority's executive area, are crucially important. Low river-flows and depleted groundwater resources, together with increased incursion of salt water from tidal flooding, are likely to be major threats to the quality of water in the Broads and the nature of the flood plain environment. Greater knowledge is needed about the hydrological functioning of much of the Broads to inform the future management of water resources. The Environment Agency's Broadland Catchment Abstraction Management Strategy programme will assess water resources within the Broads' catchment, beginning in 2004.



The little egret, once a rare visitor to the UK, now breeds in the Broads - a response to climate change.



Perch, a predatory fish that can play a vital role in maintaining clear water conditions.

Figure 5.1 **Water quality, based on the annual phosphorus load from consented discharges, has improved markedly in the Yare and Bure rivers.** (Source: Environment Agency)

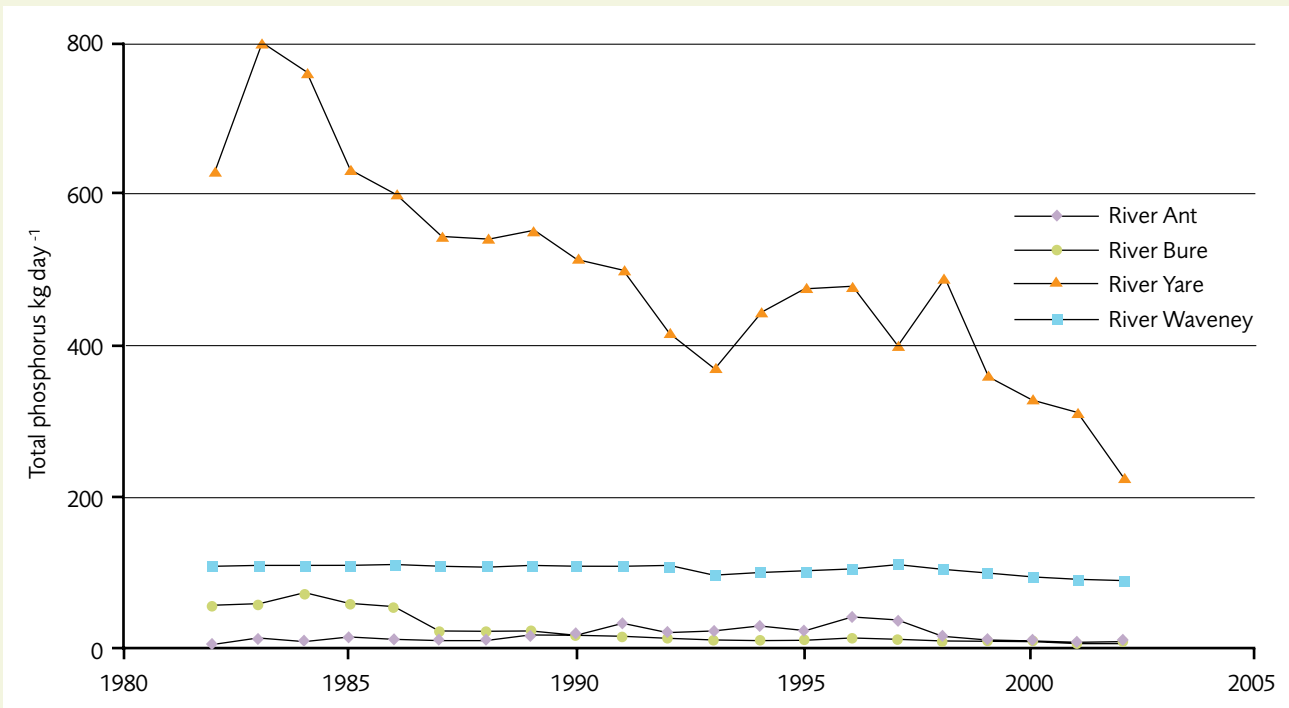
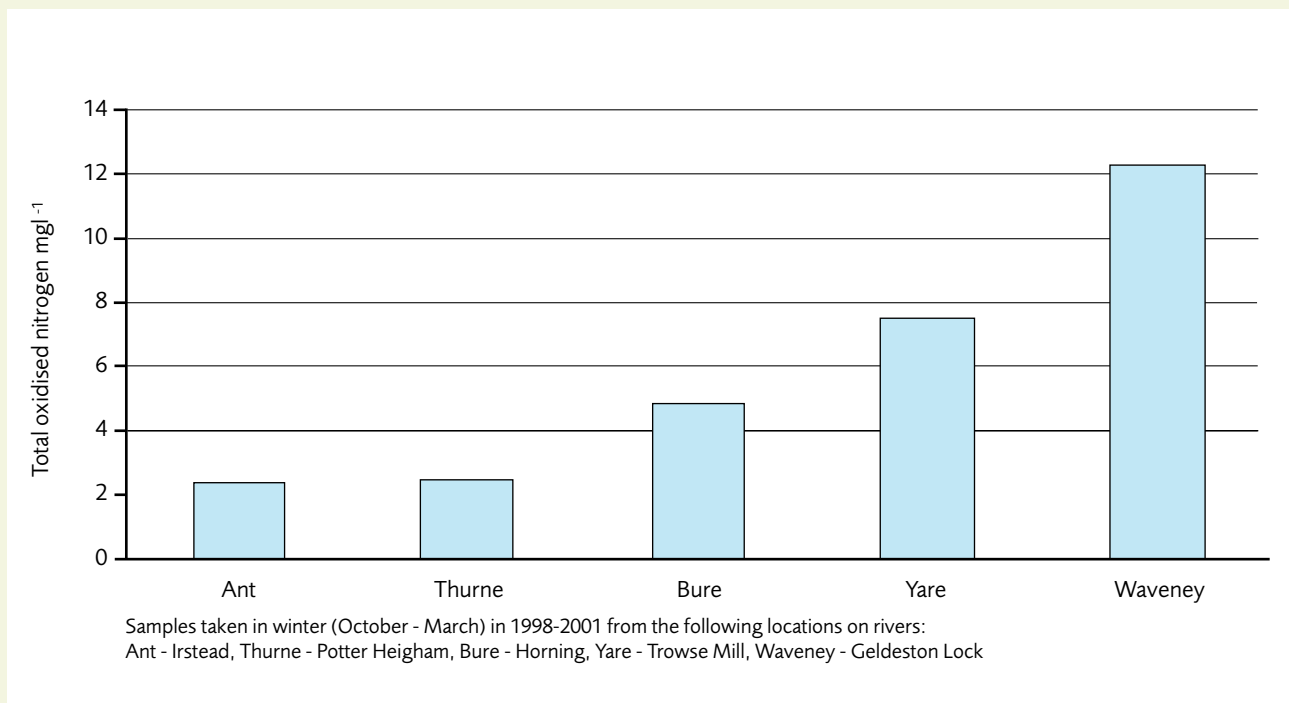


Figure 5.2 **Nitrogen concentrations in the main rivers and their tributaries, based on winter means for 1998-2001** (Source: Environment Agency)



Good quality water is clear, low in nutrients and free of harmful substances. It is characterised by a diversity of aquatic plants, as well as supporting healthy populations of fish, invertebrates and water birds. Water quality has declined enormously since the early 20th century, due to nutrient enrichment by phosphorus, mostly from sewage treatment works, and by agricultural run-off of nitrogen. Other pollutants include biocides used in agriculture and antifouling paints used on boats. Some of these pollutants become locked up in the sediment and may affect future restoration. Poor water quality affects aquatic plants and animals, and can increase sedimentation and bank erosion.

Water quality has improved markedly in recent decades due to the combined effect of improvements in sewage treatment through, for example, removal of phosphorus from sewage effluent and in agri-environment practices, such as reductions in fertilisers. Environment Agency data for phosphorus show that this has been most significant in the River Yare, where further improvements are anticipated following the introduction of phosphorus removal at Whitlingham sewage treatment works and smaller works upstream in the near future (Figure 5.1). The noticeable drop in phosphorus on the River Bure from 1987 onwards (Figure 5.1) is a direct result of its removal from sewage effluents at various treatment works in this catchment.

With respect to nitrogen, levels need to be less than approximately 2 mg l⁻¹ to support a diversity of aquatic plants. Currently, only the Ant and Thurne rivers meet this threshold; the high nitrogen levels in the River Waveney are thought to be due to arable and, in particular, livestock farming (Figure 5.2).



A major project has been completed at Barton that included dredging the entire broad to improve water quality and increase water depth for navigation. The latest initiative to install fish-proof barriers has proved effective in creating clear water conditions (seen here as darker areas of water).



Fen is maintained by a variety of methods, including grazing by Konik ponies (top) and harvesting by machine (above).

Twelve permanent water bodies are considered to be in good condition, with stable aquatic plant populations and clear water. They include such broads as Buckenham, Martham North, Martham South, Hassingham, Hickling and Ormesby. Others, such as Barton, Cockshoot and Hoveton Little have been the focus of considerable restoration efforts, but good status and stability have yet to be achieved (Map 6 page 56). Aquatic plants, such as water soldier, holly-leaved naiad, hornwort and water lilies, play a vital role in the recovery of the freshwater bodies by providing a refuge for invertebrates, such as water fleas, which eat algae and thereby keep the water clear. They also stabilise loose sediment and provide food and refuge for certain fish.

Fens and woodlands

Fens are waterlogged, peaty areas of land dominated by reed, rushes and sedge. Every fen is unique due to differences in water levels, water quality, peat structure and management. Together they form a complex and diverse mosaic of plant and animal communities.



The Broads has the largest expanse of species-rich fen in lowland Britain, enjoying international as well as national recognition. Despite a significant loss of fen in the last 100 years, about 17% of the Authority's executive area is undrained peatland. Of these remaining 5,000 ha, 1,629 ha are generally open fen and the rest has been colonised by woodland and scrub.

The 3,000 ha or so of woodland and scrub contain the most extensive and important tract of wet woodland within the region. They comprise a largely undisturbed wilderness of woody species, shade-tolerant herbs and lower growing plants. Some of these communities are recognised as being of European importance. This mosaic of open fen, scrub, mature woodland and open water is extremely valuable in terms of the wealth of species that it supports. Maintaining open fen requires active intervention. Current policy, based on the Fen Management Strategy, extends to restoring much of the fen colonised by scrub and woodland in recent decades, while ensuring that well-established wet woodland continues to be protected.

For centuries the fens were a source of peat for fuel, reed and sedge for thatching, and mixed fen vegetation for animal bedding and fodder. Commercial use of reed and sedge continues to be encouraged, in line with conservation objectives. Other management techniques developed to maintain existing open fen are harvesting by machine and extensive grazing by animals. More needs to be understood about fen hydrology and the long-term impacts of the various management techniques.

Grazing marshes

Grazing marsh, or drained marshland, consists of open, flat meadows drained by a network of ditches or dykes. In the 17th century, drainage mills began to appear on the otherwise flat horizon, and they remain a traditional characteristic of the Broads' landscape. The marshes were grazed by livestock and became recognised for their farmland bird populations, in particular waders and wildfowl, which are abundant where water levels are high. The dykes are important for aquatic plants and animals, as well as being a source of fresh water for livestock.

The grazing marshes amount to 45% (13,500 ha) of the Authority's executive area and lie within the Broads Environmentally Sensitive Area (**Map 10: Boundary of the Broads Environmentally Sensitive Area** page 60).

The ESA scheme, currently under review, has been vital in protecting the landscape through supporting the retention of traditional grazing marsh practices, although anticipated benefits for biodiversity have not been fully realised.

Estuary and coast

Breydon Water is the only tidal mud-flat on the east coast of Norfolk. It is important for its salt marsh habitat and as an internationally important staging post for numerous species of migratory birds. Its mud-flats are a food source for wintering wildfowl and waders.

The short coastal strip from north of Winterton to Horsey is particularly important for its dune habitats and associated plants and animals, such as the little tern and natterjack toad.

Plants and animals

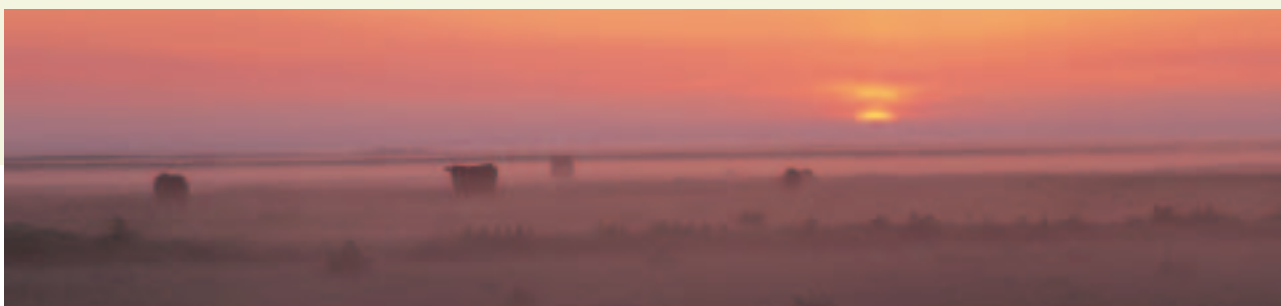
The various habitats support a wealth of plant and animal species. Some of these are rare and others are restricted in their UK distribution to the Broads (Figure 5.3). The Upper Thurne is the richest site in Britain for stoneworts, with 14 out of 21 species recorded in recent years, including the rare *Chara intermedia* found in abundance in some years at Hickling Broad.

The fens are home to over 250 species of plants. One is the milk parsley, food source for caterpillars of the swallowtail, Britain's largest butterfly. The flagship species of the fens is undoubtedly the bittern, rarely seen but now frequently heard booming during the breeding season. Once again the Broads is a stronghold for bittern, with 23-28% of the UK population of booming males. At least 12 were recorded in the Broads in 2003 out of a minimum UK population of 43 booming males.

The dykes in the grazing marshes are also particularly rich in species and feature various aquatic plants that no longer occur in certain broads (eg water soldier, Figure 5.3). Over 200 species of invertebrates have been recorded from dykes, including 65 species of water beetle and many dragonflies and damselflies. The Norfolk hawk (Figure 5.3) is the Broads Authority's logo.

Some plants and animals are less than welcome in the Broads, these being invasive species that do not occur

The Broads Grazing Marsh Scheme, introduced in 1985, provided the blueprint for Environmentally Sensitive Areas established throughout the country.





The Broads supports a wealth of plant and animal species. *Left to right:* kingfisher, small red-eyed damselfly, water avens, reed warbler, coot.

Figure 5.3 UK plant and animal populations entirely or mostly confined to the Broads

Species	Approximate % UK population	Distribution
Plants		
Intermediate stonewort <i>Chara intermedia</i>	100%	Restricted to five locations in the Broads, all in the Upper Thurne.
Starry stonewort <i>Nitellopsis obtusa</i>	>95%	Scattering of sites in the Norfolk Broads. Elsewhere, occurs in a gravel pit in Gloucestershire.
Crested buckler-fern <i>Dryopteris cristata</i>	>95%	UK population restricted to East Anglia, with stronghold in the Norfolk Broads.
Water soldier <i>Stratiotes aloides</i>	80%	Found mostly in the Broads.
Holly-leaved naiad <i>Najas marina</i>	100%	Restricted to rivers and broads in the Bure and Thurne systems.
Fen orchid <i>Liparis loeselii</i> (fen form)	50% (100%)	A dune slack form occurs in south Wales and north Devon, and a fen form is confined to the Norfolk Broads.
Invertebrates		
Norfolk hawkler (dragonfly) <i>Aeshna isosceles</i>	95%	Historically confined to the Norfolk Broads but recently colonised Suffolk Broads and Suffolk coast.
Swallowtail (butterfly) <i>Papilio machaon</i>	100%	Restricted for many decades to the Norfolk Broads.
Reed leopard (moth) <i>Phragmataecia castaneae</i>	>80%	Confined to one locality in Dorset, two in Cambridgeshire, and the Norfolk Broads.
Dotted footman (moth) <i>Pelosia muscerda</i>	100%	Not uncommon in the Broads.
Small dotted footman (moth) <i>Pelosia obtusa</i>	100%	Ant and Thurne valleys support almost the entire world population.
Birds		
Bean goose (winter population) <i>Anser fabalis</i>	60%	There are only two wintering flocks in the UK: about 150 near Stirling and 240 in the mid-Yare Valley.
Crane <i>Grus grus</i>	100%	The entire British population of about 14 birds resides in the Broads.

Figure 5.4 UK Biodiversity Action Plan priority habitats and species found in the Broads

Priority habitats	Priority species
Reedbeds	Plants
Fens	Fen orchid <i>Liparis loeselii</i>
Coastal and flood plain grazing marshes	Holly-leaved naiad <i>Najas marina</i>
Purple moor-grass and rush pasture	Floating water plantain <i>Luronium natans</i>
Mesotrophic lakes	Invertebrates
Lowland heathlands	Large Copper butterfly <i>Lycaena dispar</i>
	Snail <i>Anisus vorticulus</i>
	Medicinal leech <i>Hirudo medicinalis</i>
	Depressed river <i>Pseudanodonta complanata</i>
	Shining rams horn snail <i>Segmentina nitida</i>
	Narrow-mouth <i>Vertigo angustior</i>
	whorl snail
	Desmoulin's whorl snail <i>Vertigo moulinsiana</i>
	Amphibians
	Natterjack toad <i>Bufo calamita</i>
	Birds
	Skylark <i>Alauda arvensis</i>
	Bittern <i>Botaurus stellaris</i>
	Grey partridge <i>Perdix perdix</i>
	Song thrush <i>Turdus philomelos</i>
	Mammals
	Water vole <i>Arvicola terrestris</i>
	Brown hare <i>Lepus europaeus</i>
	Otter <i>Lutra lutra</i>
	Pipistrelle bat <i>Pipistrellus pipistrellus</i>

naturally in Britain. They rapidly populate new localities, often out-competing the native species. A classic example is the South American coypu, which caused extensive damage to reed beds and flood banks in the Broads until its final eradication in about 1989. Current invasive species include: American mink, which is increasing in the Broads and predated on waterfowl and water voles; Asiatic clam, which now occurs in all Broadland rivers and could disrupt local ecology and industry, particularly if it spreads further into British waterways; and floating pennywort, which is an extremely successful aquatic plant that has spread as far east as Cambridgeshire and is likely to seriously compromise flood control and boating if it reaches the Broads. Management problems generated by invasive species are likely to increase in response to climate change impacts, such as rising temperature.

Biodiversity Action Plans

The Broads hosts a range of habitats and species prioritised for conservation action within the framework of the UK Biodiversity Action Plan. These are listed in Figure 5.4. Other habitats and species of national conservation importance found in the Broads, including wet woodlands, eutrophic standing waters and stoneworts, will have local biodiversity action plans.



Swallowtail, Britain's largest butterfly
Insert: Milk parsley, food source for its caterpillar

Issues, aims and priority objectives

Wetland functioning and condition

Issue: The proper functioning of the Broads as a wetland depends upon it receiving enough high quality water from its catchment, much of which lies outside the national park boundary and, therefore, outside the direct control of the Broads Authority. A further constraint to addressing this issue is the current lack of knowledge of the hydrological functioning of much of the Broads. Only a small proportion of broads are in good, stable ecological condition. Some others have been the focus of considerable restoration efforts, mainly phosphorus reduction and fish removal, but good status has not yet been achieved.

20-year aim: Water bodies within the Broads will have achieved 'good' status by 2015 in accordance with provisions in the Water Framework Directive.

5-year priority objectives:

WH1 Develop a Supplementary Plan for the Broads and its catchment to augment the Anglian river basin management plan.

WH2 Develop an adaptive strategy to manage freshwater.

WH3 Develop and implement a strategy for the research, monitoring, restoration and management of rivers and broads.

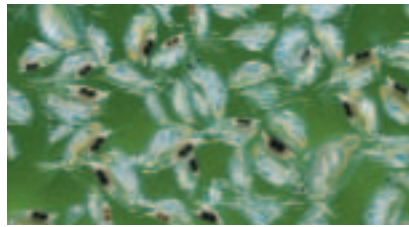
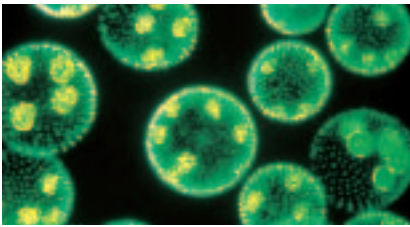
Ecological integrity of fens

Issue: Fen habitat is fragmented and greatly reduced in extent, due to changes in land use. Lack of management has also affected its viability. Some 1000 ha of fen habitat have been colonised by woodland in the last 50 years due to lack of management. Current knowledge about fen hydrology and the long-term impacts of certain management options (harvesting by machine, grazing by animals and burning) are inadequate. Moreover, fen habitat will change due to the impacts of climate change and sea level rise.

20-year aim: Approximately 2,400 ha of open fen will be restored and managed for biodiversity. The impacts of management on fen communities will be understood and ecologically sustainable, and management will be financially sustained through a wide range of social and economic benefits.

5-year priority objective:

WH4 In line with the Fen Management Strategy and the results of the Fen Audit, maintain existing open fen (1,629 ha) in good ecological condition using management techniques appropriate to the local situation.



Grazing marshes

Issue: Grazing marshes are the most extensive and visibly accessible part of the Broads' landscape. They are important for biodiversity and have great potential for enhancement through Environmental Stewardship schemes.

20-year aim: Grazing marshes will support both viable agriculture and a wealth of biodiversity, including dykes rich in fauna and flora, diverse plant communities on the peaty marshes, and a range and quantity of waders and wildfowl commensurate with the extensiveness of this habitat. Arable land will be only a part of the Broads' landscape where it contributes directly to supporting species of biodiversity importance.

5-year priority objective:

WH5 Maintain and enhance the essentially agricultural nature of the grazing marshes landscape, while also seeking opportunities for natural habitat development, including non-agricultural land, wet alluvial woodland, reed and fen vegetation.

Environmental Stewardship within the Broads and its catchment

Issue: The Broads ESA Scheme has been vital for conserving the landscape of the grazing marshes and has also been largely responsible for the onset of management of almost 1000 ha of fen. Although some of the anticipated benefits for biodiversity have not been realised, Environmental Stewardship schemes within and beyond the Broads' executive area are essential for the continued maintenance and enhancement of the wildlife and landscape of this region.

20-year aim: Environmental Stewardship schemes will be flexible and adapted to provide more effective delivery of biodiversity objectives within and beyond the Broads' executive area. The Higher Level Environmental

Stewardship will be targeted to the Broads' flood plain and adjacent valley sides, with incentives sufficient to attract a high level of voluntary uptake. Management of grazing marshes will be environmentally sustainable and financially sustained through a wide range of social and economic benefits.

5-year priority objective:

WH6 Utilise the Broads ESA scheme and Environmental Stewardship to sustain and enhance the landscape and its biodiversity, and to help manage flooding.

Biodiversity

Issue: The Broads is internationally and nationally important for a range of habitats and species, which require action to prevent or mitigate their further decline from climate change and human impacts and enhance their conservation status.

20-year aim: Biodiversity in the Broads will be protected and maintained in good ecological health, based on sustainable practices.

5-year priority objective:

WH7 Develop a Broads biodiversity strategy that informs and integrates climate change models and landscape characterisation.

Top left: Water becomes turbid when algae proliferate due to insufficient numbers of invertebrates, such as water fleas (*top middle*), to graze them. Clear water conditions can be restored by increasing predatory species, such as pike (*top right*), which control such species as bream and roach that feed on invertebrates.

Below: Aerial view of How Hill on the River Ant - location of the How Hill Trust, an environmental education centre



