Recent research in the Upper Thurne, the Broads

Broads Authority
The Broads - a member of the National Park family

Ochre in Horsey Mere

Stonewort

Sailing on the River Thurne

Pike fishing

Sea defence work

The Upper Thurne is a mosaic of internationally important water-bodies and wetlands set within a diverse rural economy. Managing this complex landscape for the benefit of wildlife and people requires an understanding of how the system works.

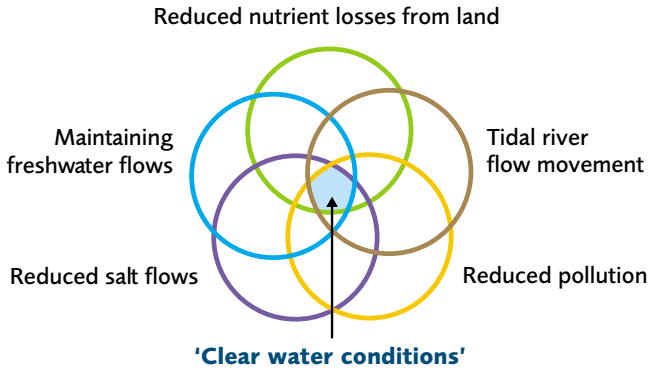
A workshop in 2001, hosted by the Broads Authority and attended by scientists, local interest groups, residents and other interested parties, prioritised the work necessary to provide the evidence upon which to base future management of the Upper Thurne. This leaflet summarises the results to date of this research programme.

Why the Upper Thurne is unique

The Thurne Broads are the richest site in the UK for nationally important and rare water plants known as stoneworts or *charophytes*. They are also important for fishing, sailing and motor cruising, as well as for winter waterfowl and rare birds such as the bittern.

Why the need for research?

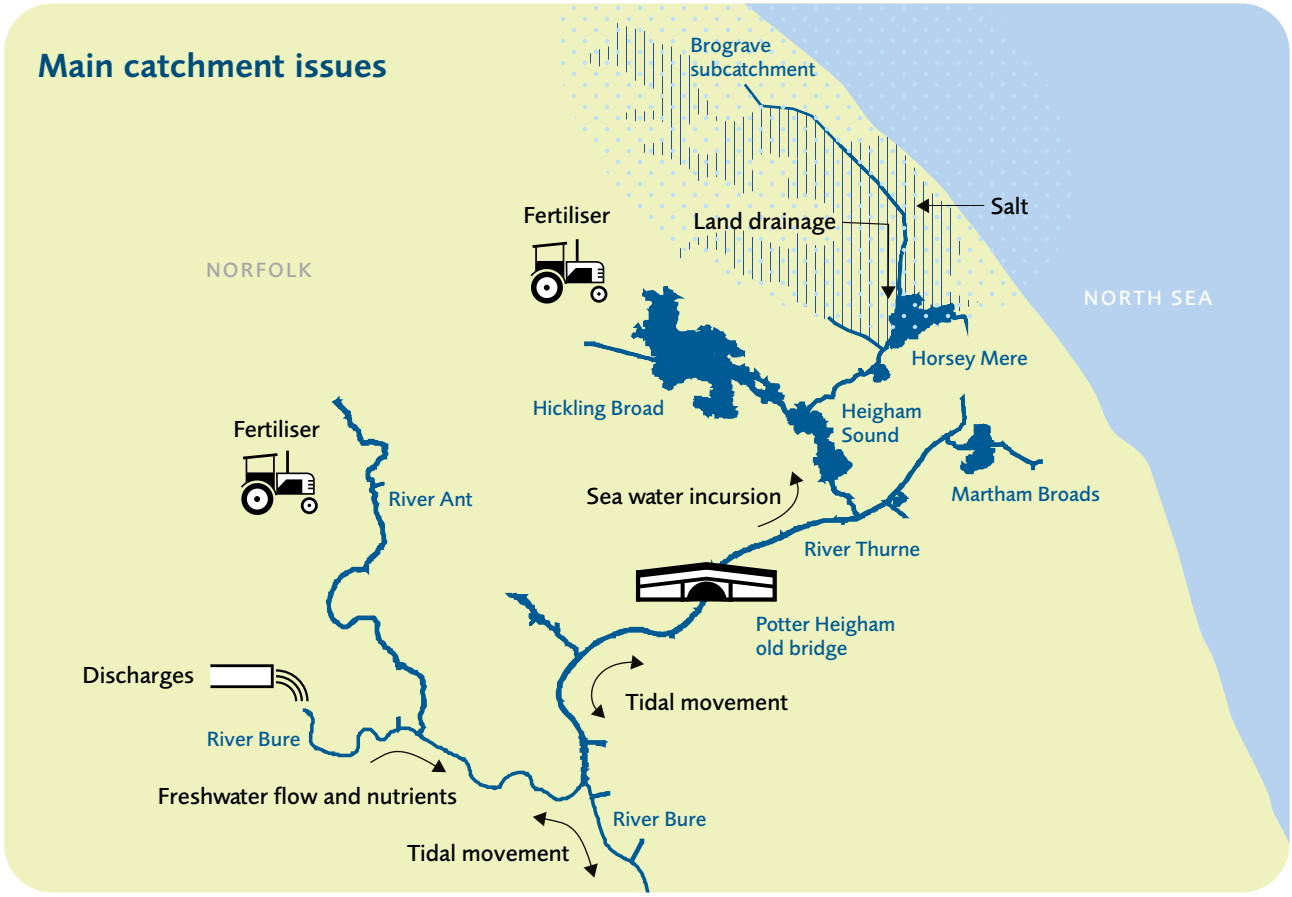
Stoneworts started to re-appear in Hickling Broad during the early 1990s as water quality improved. For about 25 years prior to this, the water in the Upper Thurne Broads of Hickling, Horsey and Heigham Sound was murky due to the dominance of algae. However, after a few years of good growth, there has been a return to murky water and extensive die-back of stoneworts, threatening the conservation status of Hickling Broad. The causes of this unstable population of rare plants are linked to the conditions in the broads. Research was required to establish quantities of nutrients and salt coming from the catchment to form a scientific basis for management decisions.



What research has been done?

The research has focussed on improving our understanding of the:

- environmental needs of stoneworts;
- sources and transport of nutrients (especially phosphorus and nitrogen) from the catchment to the rivers and broads;
- movement of water and salt within the rivers and broads;
- salt water discharged from the land drainage pumps which maintain drain water levels below sea level;
- improved ways of monitoring the ecological 'health' of the broads.



Environmental needs of the stoneworts

Why The environmental requirements for stonewort growth and reproduction are poorly understood, yet the stoneworts are an important conservation feature of the Upper Thurne Broads.

How Fieldwork, studies of lake sediment cores and laboratory studies looking at the response of stoneworts to different environmental conditions.

Findings These studies have shown that:

- Increased water temperature leads to considerably higher growth rates and seed production of stoneworts, suggesting that climate change may influence future growth patterns;
- While laboratory plant cutting experiments showed that cut stems had the ability to re-grow and branch, uprooting of stoneworts, which is a risk of weed harvesting on the broad, leads to a high rate of plant mortality;
- Stoneworts are affected by a range of chemicals in boat antifouling paints, which prevent algae and shellfish from growing on boat hulls;
- One of these chemicals, TBT[1], has been found in sediment dating back to the early 1970's in Hickling Broad, although TBT is no longer used in the Broads;
- The growth of stoneworts is likely to be more vigorous at low salinities, thus permitting cutting. Stoneworts can probably withstand a salinity increase of no more than 10 % of typical recent values for Hickling Broad;
- Once stoneworts begin to die back as a result of poor water quality, they find it impossible to recolonise the bare loose sediment on the bed of Hickling Broad. Stoneworts in Hickling seem to require shelter from other plants to help them grow in this wind-exposed shallow waterbody.

[1] Tri-butyl Tin

Sources and transport of nutrients from the catchment to the rivers and broads

Why After many years of improving effluent quality from sewage treatment works, attention is turning to controlling agricultural losses of nitrogen (N) and phosphorus (P), which play a role in the increased growth of algae. There is a need to better understand nutrient sources and transport within the catchment.

How A combination of identifying nitrogen source hotspots, analysis of water samples from across the catchment and a computer model of the catchment to simulate the effect of future changes on nutrient losses.

Findings The research to date has shown that:

- Stoneworts prefer water with low N and P concentrations. The Thurne Broads have generally lower concentrations of N compared to other Broads rivers, such as the Yare and Bure;
- Phosphorus concentrations in the Upper Thurne Broads regularly exceed the target limit for favourable conditions;
- Agricultural drains and water from the drainage pumps have the highest N concentrations, but N concentrations in the broads are reduced through biological uptake or sedimentation;
- Increased rainfall and higher temperatures through climate change will increase nutrient (N and P) and sediment losses from the land;
- Insufficient irrigation water to support current agricultural practices is likely in the predicted drier and warmer summers of the future;
- Erosion control measures, on susceptible soils and slopes, should be employed as part of good agricultural practice to reduce sediment and nutrient losses;
- Reversion of agricultural land to wetland, heath or woodland could reduce nutrient losses, aid the storage of water, retain soils and enhance biodiversity.

The movement of water and salt within the rivers and broads

Why Water levels within the River Thurne and its broads go up and down with the tides. Normal methods of measuring river flows cannot be used, so the controls on the movement of water and salt in the Thurne system are poorly understood.

How A computer model of the Broads river system has previously been developed by BESL (Broadland Environmental Services Ltd). The representation of the Upper Thurne in this model has been improved.

Findings To improve the simulation of water and salt within the Thurne model has required the following components to be both understood and represented;

- Water and salt being discharged from the land drainage pumps form the main source of water and salt entering the River Thurne from its catchment;
- Constrictions within the river system, principally at Potter Heigham old bridge, where the narrow openings within the bridge impede both the downstream and upstream movement of water (depending upon tidal conditions);
- Flows within the River Bure upstream of Thurne Mouth as, during high tides, water from the Bure can 'back-up' into the River Thurne;
- Having developed an improved, locally relevant model of the Thurne river and broads, scenarios are being run to better understand the movement of water and salt under a range of weather and tidal conditions;
- Opportunities to create new downstream wetlands to create washland habitats and alleviate flooding are being explored.

The importance of land drainage

Why The Thurne marshes have been drained for several centuries. The drainage pumps discharge significant amounts of salty water coloured with iron-rich 'ochre' into the Upper Thurne, which (at current levels) are harmful to aquatic life.

How Computer modelling has been used to simulate the effects of the current land drainage management on groundwater and drain water salinity, and to investigate the potential effects of changes in drainage management on salinity.

Findings The research has shown that:

- The drainage pumps discharge a varying mix of storm runoff, fresh groundwater which has flowed from the higher land, saline groundwater that originated from the sea and leakage through the flood walls. For example, the saltiness of the water from the Brograve pump is equivalent to 15-20% sea water;
- Much of the salinity in the Brograve drainage subcatchment enters via the coastal marshes, especially Hempstead marshes;
- Changes to the management of the land drainage systems have the potential to reduce the salinity entering the rivers and broads from the pumps;
- Preliminary results suggest that raising the water levels in the Hempstead Marshes by up to 1 metre might lead to a 15% reduction in the amount of salt being discharged by drainage pumps;
- Such changes need to be considered in conjunction with changes in flood risk and the knock-on effects to neighbouring drainage systems.

Looking down from above

Why Conventional field-based approaches can be inefficient for monitoring the ecological status of these complex shallow lakes and wetlands.

How The potential contribution that data collected from sensors mounted on aircraft and satellites may make to monitoring programmes in the lakes and wetlands of the Broads was investigated.

Findings The results obtained demonstrated that such 'remote sensing' data can be used to:

- Map the development of algal blooms in the broads, potentially providing early warnings for water users such as sailing clubs;
- Distinguish the presence of potentially toxic blue-green algae from other non-toxic species;
- Map the distribution and health of aquatic plants, both around the margins of the broads and, if the water is clear, those submerged beneath the water's surface.

Further study

The research described in this leaflet has laid a good foundation and the key outputs, to be collated in a detailed Synthesis of all recent research in the Upper Thurne, will inform the Upper Thurne Water Space Management Plan. Future research and monitoring are still needed to address*:

- Development of an integrated catchment-broads-ecosystem model to inform improved management within the context of climate change;
- Community and economic perception and involvement with changing coastal and wider climate change issues;
- The greenhouse gas issues (carbon dioxide and nitrous oxide) of different forms of land management e.g. how much carbon is stored or lost;
- Monitoring of the effects of any changes to drainage management;
- Continued monitoring of water quality, aquatic ecology and year-on-year weed cutting to support management decisions.

*The list of future research and monitoring is a draft, and will be subject to further discussion

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