

NORFOLK BIODIVERSITY ACTION PLAN

MESOTROPHIC LAKES

These lakes are characterised by having a medium nutrient status, their main defining indicators being the concentration of inorganic nitrogen and total phosphorous. They potentially have the highest plant diversity of any lake type, and, relative to other lake types, they contain a higher proportion of nationally scarce and rare aquatic plants. Macro-invertebrates are well represented, with particularly important groups being dragonflies, water beetles, stoneflies and mayflies.

1. CURRENT STATUS

National Status

- Mesotrophic lakes (ie those in the middle of the trophic range) are relatively infrequent in the UK and largely confined to the margins of upland areas in the north and west.

Norfolk Status

- Within the Broads Natural Area three mesotrophic lakes remain in good condition, these being Blackfleet Broad, Martham South Broad and Upton Broad. A further eleven lakes (Brundall Gardens Lake, Calthorpe Broad, Hickling Broad, Horsey Mere, Martham North Broad, Heigham Sound, Ormesby Broad, Alderfen Broad, Rockland Broad, Strumpshaw Broad and Cockshoot Broad) usually possess clear water with luxuriant growth of several kinds of plants, but have higher nutrient levels. These lakes have the potential to be restored to a mesotrophic state.

2. CURRENT FACTORS CAUSING LOSS OR DECLINE IN NORFOLK

- Enrichment by excessive nutrients (eutrophication) is the main damaging factor, sources of which include sewage effluent, and point and diffuse sources associated with agriculture. These effects can be exacerbated by water abstraction, leading to a reduction in the quality of water reaching the lake. Abstraction may also affect the residence time of water in the lake, increasing the time available for nutrient uptake by aquatic plants and algae, and so enhancing plant production. The resulting prolific plant growth is the first symptom of eutrophication.
- At some sites water-borne traffic can damage aquatic plants; bankside erosion, weedcutting to enable navigation, passage of boats through stands of vegetation and the cutting action of propellers all contribute. Increased turbidity from boatwash may also compound water-plant loss. The suppression of water plant communities by these mechanisms may favour algal growth.
- Ploughing of grassland and surrounding habitats, and under-drainage of agricultural land, both increase soil erosion with a consequent increase in water-borne sediment. Sediments raise the nutrient status of the lake and increase turbidity favouring algal dominance.
- Inappropriate introductions, or modification of fish communities can also adversely affect the natural integrity of mesotrophic lakes.

Ref 1/H9	Tranche 1	Habitat Action Plan 9
Plan Author:	English Nature	
Plan Co-ordinator:	English Nature	
Plan Leader:	Waterbodies Group	
Date:	Stage:	
31 December 1998	Final Draft	
May 2000	Under Review	
December 2000	Under Review	

NB: The treatment of all lake types in the BAP process is under review, and is likely to be changed nationally.

3. CURRENT ACTION

- The three mesotrophic lakes remaining in the Broads are protected as Sites of Special Scientific Interest, and are also components of The Broads candidate Special Area of Conservation (cSAC) and Broadland Ramsar site. Many of the sites that could be restored to a mesotrophic condition also receive statutory protection, and several of the lakes are managed by conservation bodies. The Broads Authority undertakes extensive monitoring of aquatic plant assemblages throughout the series of broads. Research in the Broads has established the feasibility of reversing the effects of eutrophication through programmes of nutrient reduction, allied to 'biomanipulation' programmes aimed at managing the populations of fish predators. These techniques can also be applied to mesotrophic lakes undergoing nutrient enrichment. In some cases, sediment removal has been necessary. Some mesotrophic lakes are subject to, or will soon be subject to, Water Level Management Plans prepared by flood defence operating authorities. Research has been commissioned to investigate the hydrology and hydrogeology of Upton Broad and Fen. The Environment Agency carries out an extensive programme of water quality monitoring in Broadland.

4. ACTION PLAN OBJECTIVES AND TARGETS

National

- Maintain the characteristic plant and animal communities of current mesotrophic lakes.
- Identify and implement effective remedial action to address nutrient-enrichment in polluted mesotrophic lakes by 2010.

Norfolk

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Mesotrophic Lakes - Norfolk Action Plan

NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.1	Policy and Legislation			
5.1.1	Establish the Water Quality Objectives and associated nutrient standards appropriate for mesotrophic lakes by 1998 and aim to meet targets by 2005.	Establish the Water Quality Objectives and associated nutrient standards appropriate for mesotrophic lakes by 1998 and aim to meet targets by 2005. Incorporate into Broadland Rivers Local Environment Agency Plan.	EA, EN and BA	
5.1.2	Prepare water quality management plans for the Erne catchment by 2000.	Not applicable.		
5.1.3	Review water resource uses where mesotrophic Sites of Special Scientific Interest lakes are affected by excessive abstraction by 1998 and aim to meet targets by 2010.	Review water resource uses where mesotrophic Sites of Special Scientific Interest lakes and their catchments are affected by excessive abstraction by 1998 and aim to meet targets by 2010.	EA	
		Water abstraction licences potentially affecting European Sites will be investigated under the 'review of consents' procedure to be completed by 2010.	EA	
5.1.4	Review appropriate fisheries management policy, for those Sites of Special Scientific Interest mesotrophic lakes affected by fisheries-related impacts, by 1998 and implement site management plans by 2005.	Review appropriate fisheries management policy, for those Sites of Special Scientific Interest mesotrophic lakes affected by fish-related impacts, by 1998 and implement site management plans by 2005.	EA, EN and BA	

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.1.5	Consider expanding the scope of appropriate agri-environment schemes (eg WES, Tir Cymen, Environmentally Sensitive Areas, Countryside Stewardship) to target vulnerable mesotrophic lakes, promoting the use of buffer zones as necessary.	Promote the establishment or retention of balanced fish populations, with a high proportion of fish-eating species (e.g. pike and perch), to help conserve the ecological stability of mesotrophic lakes. Consider expanding the scope of appropriate agri-environment schemes (eg the Broads Environmentally Sensitive Area) to target vulnerable mesotrophic lakes, promoting the use of buffer zones as necessary.	DEFRA (RDS)	
5.1.6	Develop a national strategy for the control of eutrophication in England and Wales.	Contribute to the development of a national strategy for the control of eutrophication in England and Wales by 1998.	EA, BA and EN, DEFRA (RDS)	
5.1.7	Ensure that forestry policy takes full account of the sensitivity of mesotrophic lakes to nutrient enrichment and acidification.	Not applicable.		
5.2	Site Safeguard and Management			
5.2.1	Complete programmes for notification of mesotrophic lake Sites of Special Scientific Interest by 2001.	Complete programmes for notification of mesotrophic lake Sites of Special Scientific Interest by 2001.	EN	
5.2.2	Agree by 1998 a priority list of lakes requiring remedial treatment.	Agree remedial action for Upton Broad.	EA, EN, NWT, Norwich Union, BA	

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.2.3	Ensure that all Sites of Special Scientific Interest mesotrophic lakes have a site management plan implemented by 2005, taking full account of all impacts including inappropriate levels of recreation.	Ensure that all Sites of Special Scientific Interest mesotrophic lakes have a site management plan implemented by 2005, taking full account of all impacts including inappropriate levels of recreation.	EN and NWT	
5.2.4	Continue to offer long-term management agreements to protect mesotrophic Sites of Special Scientific Interest.			
5.2.5	Agree conservation strategies and consenting protocols for mesotrophic lake Sites of Special Scientific Interest with relevant statutory and non-statutory agencies.	Agree 'The Rivers and Broads' conservation strategy and consenting protocols for mesotrophic lake Sites of Special Scientific Interest with relevant statutory and non-statutory agencies.	BA, EN, EA and NWT	
5.3	Species Management and Protection			
5.3.1	Promote the use of best practice management techniques and, for polluted lakes, restoration measures.	Promote the use of best practice management techniques and, for polluted lakes, restoration measures, such as biomanipulation and mud-pumping.	EA and BA	
5.4	Advisory			
5.4.1	Prepare joint water quality management plans with the Republic of Ireland regarding those catchments which have cross-country components.	Not applicable.		

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NATIONAL ACTION		NORFOLK ACTION	ACTION BY:	PARTNERS:
5.5	Future Research and Monitoring			
5.5.1	Investigate the effectiveness of remedial action against nutrient enrichment in mesotrophic lakes.	Research restoration of mesotrophic lakes. Monitor the effectiveness of restoration techniques.	EA and BA	
		Monitor numbers, extent and quality of mesotrophic lakes.	EA and BA	

NORFOLK DISTRIBUTION

(to be mapped)

MANAGEMENT GUIDANCE

(This guidance is a general summary; for detailed information or advice consult the references or contacts below.)

Mesotrophy is a term applied to waters of moderate fertility. Interim standards for mesotrophic waters range from 25 micrograms per litre (annual average) total phosphorus in standing waters to 60 micrograms in running waters (Environment Agency 2000). Newbold (undated) gives a value for total inorganic nitrogen in mesotrophic waters of between 300 and 650 micrograms per litre. Mesotrophic lakes sustain abundant aquatic macrophyte growth with a diverse fish and invertebrate community. Competition from plants for nutrients keeps levels of microscopic algae in check, as does the grazing action of water fleas (*Daphnia*). *Daphnia* utilise the macrophyte beds for protection from fish species (planktivores) that would otherwise eat them. Piscivorous fish such as pike, which predate the planktivores, also use macrophyte beds for shelter. The whole system is therefore self-regulated. Once the macrophyte beds are lost, however, they are difficult to restore as the above biological feedback mechanisms are lost.

The management of mesotrophic lakes, or those that have the potential to be restored to a mesotrophic status, should follow a number of logical steps as outlined below (Moss *et al*, 1996).

1. Identification of factors which degrade the system. These are the causes of macrophyte loss and include direct effects such as mechanical damage caused by boats, wildfowl and fish grazing, or herbicide use. They also include indirect impacts such as the loss of water fleas through pesticide use or saline intrusion, which alters the ecological balance and hence self-regulation of the system. Steps should be taken to address any adverse factors which are identified.
2. Identify and control nutrient sources. Identification can be achieved by constructing a nutrient budget from known point sources along with export modelling from diffuse catchment sources (Johnes *et al*, 1996). This can provide valuable information on where to direct efforts if nutrient reduction is required. Alternatively, you may consider isolating the lake from sources of nutrient inputs. This was done at Cockshoot Broad which was isolated from the nutrient rich River Bure in the early 1980's (Moss *et al*, 1996). Reduction of the release of nutrients from sediments may be required, as this can act as a source of further enrichment. Techniques include sediment removal and chemical sealing. For details please refer to Pitt *et al*, 1997.
3. Biomanipulation. This is a technique used to reduce algal densities in degraded lakes by promoting the proliferation of water fleas. It involves either the removal of planktivorous fish such as roach and young perch or the stocking of piscivorous fish such as pike and perch, or a combination of both (Stansfield *et al*, 1997). The area biomanipulated will need to be isolated to stop fish migration. For details of barrier designs used in Broadland please refer to Holzer *et al*, 1997.
4. Re-establish plant beds. The major obstacles to successful establishment come from grazing, sediment stability problems and the presence of a suitable inoculum of plant species. (Schutten *et al*, 1997). You may wish to exclude grazing birds and bottom feeding fish such as carp and bream from the area where plants are regenerating. There may be benefits to providing shelter to such areas to decrease wind induced

sediment movement, and there may be a need to introduce suitable inocula if insufficient is present at the site. Inocula will generally be in the form of vegetative propagules.

Many of the above techniques are those used to rehabilitate lakes which are already enriched. They are, however, applicable to lakes where the objective is to maintain mesotrophic status. Monitoring is also an important aspect of site management. It is essential that the quality of the habitat be monitored to detect any change in status at an early stage. Wider catchment monitoring can be used to detect possible changes that may impact on the lake.

The development of an integrated strategy is recommended. There are often many potentially conflicting pressures acting on a water body that should be considered (Environment Agency, 2000).

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PROGRESS ON PLAN ACTIONS (as at 27/02/01)

	Norfolk Action	Comments
5.1.1	Establish the Water Quality Objectives and associated nutrient standards appropriate for mesotrophic lakes by 1998 and aim to meet targets by 2005. Incorporate into Broadland Rivers Local Environment Agency Plan.	England Lakes HAP group established 2001 to implement HAP actions.
5.1.2	Not applicable.	
5.1.3	<p>Review water resource uses where mesotrophic Sites of Special Scientific Interest lakes and their catchments are affected by excessive abstraction by 1998 and aim to meet targets by 2010.</p> <p>Water abstraction licences potentially affecting European Sites will be investigated under the 'review of consents' procedure to be completed by 2010.</p>	<p>Review of consents ongoing. Broads sites given priority 1 status as a result of site issues briefing.</p> <p>New licences being determined in light of Habitats Directive requirements.</p> <p>Detailed monitoring has been ongoing (by EA and applicants) into the impacts of groundwater abstractions potentially affecting Upton Broad and Martham South Broad.</p>
5.1.4	<p>Review appropriate fisheries management policy for those Sites of Special Scientific Interest mesotrophic lakes affected by fish-related impacts, by 1998 and implement site management plans by 2005.</p> <p>Balanced fish populations with a high proportion of fish-eating species, pike and perch, are crucial to conserving the ecological stability of mesotrophic lakes.</p>	Broads Angling strategy developed. Fisheries Action Plan work ongoing (joint EA/BA initiative).
5.1.5	Consider expanding the scope of appropriate agri-environment schemes (eg Broads Environmentally Sensitive Area) to target vulnerable mesotrophic lakes, promoting the use of buffer zones as necessary.	
5.1.6	Contribute to the development of a national strategy for the control of eutrophication in England and Wales by 1998.	National Strategy published 2000. River Ant is A-list site for development and implementation of Eutrophication Control Action Plan.
5.1.7	Not applicable.	

	Norfolk Action	Comments
5.2.1	Complete programmes for notification of mesotrophic lake Sites of Special Scientific Interest by 2001.	Trinity Broad (includes Ormesby Broad) notified as an SSSI in 1999.
5.2.2	Agree remedial action for Upton Broad.	
5.2.3	Ensure that all Sites of Special Scientific Interest mesotrophic lakes have a site management plan implemented by 2005, taking full account of all impacts including inappropriate levels of recreation.	
5.2.5	Agree 'The Rivers and Broads' conservation strategy and consenting protocols for mesotrophic lake Sites of Special Scientific Interest with relevant statutory and non-statutory agencies.	Work on Rivers and Broads Strategy by Broads Authority ongoing.
5.3.1	Promote the use of best practice management techniques and, for polluted lakes, restoration measures, such as biomanipulation and mud-pumping.	Restoration works being undertaken at a number of Broadland sites including Ormesby Broad, Alderfen Broad, Cockshoot Broad, Hickling Broad, Horsey Mere, Martham Broads and Heigham Sound. Environment Agency is piloting Eutrophication Control Action Plans, including production of a guidance manual.
5.4.1	Not applicable.	
5.5.1	Research restoration of mesotrophic lakes. Monitor the effectiveness of restoration techniques. Monitor numbers, extent and quality of mesotrophic lakes.	Ongoing monitoring programme undertaken by EA and BA. Upton Broad and Martham South monitored as part of this programme.

PROGRESS ON PLAN OBJECTIVES AND TARGETS