

The addition of artificial macrophytes to provide macroinvertebrate refugia at Alderfen Broad, Norfolk, England

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SUMMARY

Nylon Italian cobweb brushes were added to Alderfen Broad to provide a refuge for zooplankton and other invertebrates. These were colonised quickly, initially largely by chironomids but then by a greater diversity of taxa. In the second year, there was a vigorous build-up of sponges.

BACKGROUND

The Broads is an area of man-made, interlinked shallow freshwater lakes in Norfolk and Suffolk, eastern England. There are over 200 km of navigable waterways, with many more connecting small waterways such as streams and dykes. These link a variety of habitats that support a rich diversity of flora and fauna, including some of the rarest wildlife in Britain. The main habitats are the rivers and broads (shallow lakes) themselves, fen, carr woodland and grazing marshes. Much of the water in the Broads has been affected by excessively high levels of phosphates and nitrates draining off from agricultural land, and sewage pollution.

The Broads Authority was set up in 1989, with responsibility for conservation, planning, recreation and waterways management. Restoring water quality is the basis of much of the ongoing conservation work.

ACTION

Study site: Alderfen Broad (29 ha) is situated on shallow fenland peat in a side valley of the River Ant in north Norfolk. It is a Site of Special Scientific Interest (SSSI). The habitats consist of open water, reed *Phragmites australis* swamp and alder *Alnus glutinosa* carr woodland. Alderfen has been undergoing habitat restoration following eutrophication caused by decades of excessive input of nutrients derived mostly from water running off heavily fertilised agricultural land.

As part of ongoing restoration work, the inflowing stream was diverted to prevent

further inputs of catchment-derived nutrients from entering the broad. Also, in 1992 a suction dredging operation was undertaken to remove nutrient rich mud from the bed of Alderfen Broad to reduce phosphorus release (which encourages algal growth).

The purpose of artificial macrophytes: The Broads Authority, along with partners (English Nature and the Norfolk Wildlife Trust), initiated a project in 2000 to further restore Alderfen Broad. Nutrient overload (nitrogen and phosphorus) had led to excessive growth of algae and occasional 'blooms' of blue-green algae. The algae, which grew unchecked in the nutrient-rich water, shaded out all other submergent water plants (macrophytes and charophytes). Without the structure provided by these plants, invertebrates have nowhere to shelter from predators, and little opportunity to graze on periphyton. Invertebrates such as zooplankton provide a critical role in maintaining water quality by consuming algae, thus preventing other aquatic plants from being shaded out.

Furthermore, with few invertebrates to eat, the fish community was less diverse, which also had implications for water quality. In a clear-water state there is a variety of piscivorous fish species (e.g. percids) which in their mature life stage consume mainly juvenile planktivorous fish. Having a variety of fish species consuming planktivores releases large zooplankton from predation, which can then control the algae. However, it is important that these juvenile fish, especially perch *Perca fluviatilis*, have sufficient macroinvertebrate prey to enable them to grow fast enough to



Figure 1. Photograph of the Italian cobweb brushes used as artificial macrophytes at Alderfen Broad.

complete the developmental dietary change to become piscivorous. Without piscivorous predators, recruitment of young planktivorous fish is left uncontrolled which leads to high water turbidity. In other words, the presence of a healthy and diverse macroinvertebrate community may act as a feedback mechanism which helps to stabilise the ecosystem.

The aim of the Alderfen experiment was to determine whether the installation of artificial

macrophyte structures increased the potential invertebrate food resource available for perch growth.

Installation of artificial macrophytes: A 30 m² area was enclosed using temporary plastic ‘fish curtains’ in May 2000. Within the refuge, artificial macrophytes were installed using ‘Italian cobweb brushes’ strung in bunches between posts. (Fig. 1) The brush bristles were made of nylon, roughly 10 cm in length, so each near-spherical brush head had an approximate 20 cm diameter. The handles were about 10 cm long and were used to attach the brushes to each other. Bunches of four plus brushes were suspended by ropes attached to posts installed in the water. The purpose of the brushes was to mimic native plants e.g. rigid hornwort *Ceratophyllum demersum* which provide zooplankton and other invertebrate with refugia.

Sampling of invertebrates: Samples of the aquatic macro-invertebrate fauna were taken using a standard protocol developed by Jackson (1997). This is a semi-quantitative technique using a 1 mm ISO hand-net for a timed period. One-minute samples were taken around randomly selected strings of brushes. After this net sampling, the brushes were pulled out of the water and sessile invertebrates dislodged by vigorous shaking. Similar timed net sampling was also conducted in the surrounding littoral vegetation for comparison.

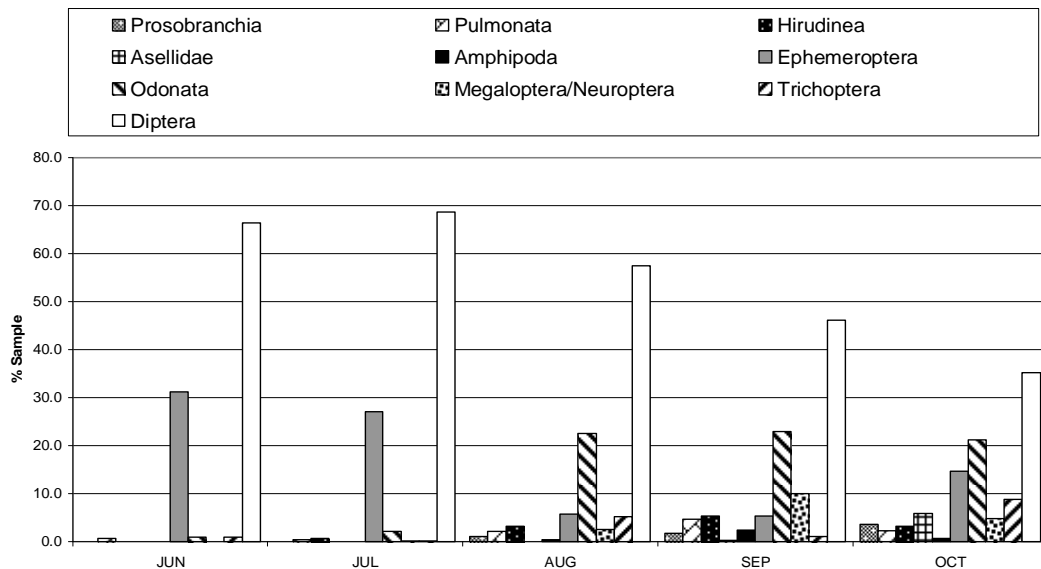


Figure 2. The proportions of invertebrate taxa within the Alderfen Broad refugia, June to October 2000 (source: Jackson M.J. 2001).

CONSEQUENCES

In the first five months after installation of the artificial macrophytes, the invertebrates inside the brush refugia showed a clear colonisation pattern, with small grazing chironomids dominant early on, with gradual increased presence of different invertebrate groups, notably molluscs and detritus feeders (e.g. water louse *Asellus aquaticus*). See Figure 2 for proportions of invertebrate taxa within the refugia. In the brush refuges, the total number of individual invertebrate taxa and absolute number of individuals was greater than in the surrounding impoverished natural littoral vegetation.

Invertebrate samples were collected on a monthly basis the following year but have yet to be analysed. Vigorous build up of freshwater sponges infested the brushes during the second year, but the impact on total invertebrate numbers and community compositional change is not yet known.

Conclusions: The benefit of using cobweb brushes as artificial macrophytes was their initial colonisation by invertebrates. This was due to increased surface area available for feeding (on algae etc that had colonised) and refugia provided by the brushes. Colonisation by sponges occurred in 2001 and it is currently

unknown what the impact has been on invertebrate abundance and diversity. However, a similar project at Barton Broad in 2001 (Kelly 2006) also showed that sponges colonised the brushes over time. It is believed that despite the presence of sponges, invertebrates continue to gain long-term refuge benefit but possibly at a reduced level. Despite some positive outcomes, the use of these artificial refugia is unlikely to be repeated due to short term beneficial nature of the effects, the expense, and the practical difficulties of installation and removal.

REFERENCES

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