Hoveton Great Broad biomanipulation

Historical plant and fish communities of Hoveton Great Broad

Prior to the major degradation of the Norfolk and Suffolk Broad after the 1950s-1970s much evidence from palaeoecological studies, combined with historical macrophyte records and natural history descriptions, suggest species-rich wetland plant communities growing in clear waters. The temporal sequence of aquatic plant decline varies across the different Broads river systems due to variation in background water chemistry, water depth and tidal influence. The Broads of the River Bure, including Hoveton Great Broad, appear to differ somewhat from those associated with other rivers (especially the Thurne and Ant Broads) in being less dominated by stoneworts (Characeae) in their pre-eutrophication (especially pre-1900s) phase. Gurney (1904) comments on the Bure Broads (although not specifically on Hoveton Great Broad) as follows "*All these Broads differ from those of the preceding groups in respect of their wooded surroundings, and in having, as a rule, comparatively little weed. In particular the Characeae are, if not absent entirely, are at least never seen in any luxuriance*". That plants were absent from Hoveton Great Broad is not at all borne out by other information sources, however. Palaeoecological data suggests that charophytes were present in abundance in certain areas of Hoveton Great Broad and especially points to a more spatially widespread historic dominance of water-lillies (*Nuphar lutea* and *Nymphaea alba*) and *Ceratophyllum demersum* (Hoare, 2007; Goldsmith *et al.,* 2015). In addition, Davies (1883) describes Hoveton Great Broad as "*fast growing up and dotted all over with beds of rushes* (no doubt *Schoenoplectus lacustris*)" and also points to dominance of "*the American weed Anacharis alsinastrum*" (=*Elodea canadensis*). The combination of evidence suggests, therefore, that prior to the 1950s, as for many of the Broads (Madgwick *et al.,* 2011), Hoveton Great Broad supported extensive *Phragmites australis* development grading into an in-lake swamp community with scattered patches of *S. lacustris* and water-lillies, in-between which submerged macrophytes would have thrived, especially *C. demersum, Myrophyllum spicatum, Elodea canadensis, Stratiotes aloides* and in some areas *Chara* spp. This situation is clearly evidenced by a collation of aerial photographs for the site (**Fig. 1** - Sayer *et al.,* 2006) which shows extensive reedswamp development in Hoveton Great Broad in 1948 and a severe and indeed rapid decline thereafter, as discussed and evidenced further in George (1992). A comment on *S. aloides* by Lambert (1965) illustrates the speed of the decline of Hoveton Great Broad, with the plant described as *"abundant in 1947 but completely absent six years later".*

The fish communities of the Broads in the past can be understood from historical descriptions of 'angler-naturalists'. Davies (1883) discusses the fish of the Broads and talks on a number of species. The first fish he refers to is common bream which he says *"first deserves mention because of its enormous numbers"*. He talks on roach which he says *"almost equals the bream in point of numbers"*. Thus, as is the case in the present day, common bream and roach were important and abundant species in the past. However, Davies (1883) also talks on species which are now very uncommon in the open, boated Broads system including rudd, which is described as "*very abundant*", perch which he says "*are numerous and large*" and tench which are "*common and large*". Catches of fish in the Broads were very clearly immense in the late nineteenth century and Dutt (1903) noted that *"bushels of roach, bream and rudd were left to rot on the riverbanks".*

The current low abundance of perch, rudd and tench in the Broads, including in Hoveton Great Broad, is very clearly linked to a near complete absence of the structured plant habitat which these species favour and which tends to impair the foraging efficiency of species such as roach and common bream (Winfield, 1986; Diehl, 1988). Indeed, common bream have a strong association with plant free and turbid waters in European shallow lakes (Meijer *et al.,* 1990; Hansen *et al.,* 2019). It may well be that, in the past, the plant dominated waters of the Broads, were dominated (at least in terms of larger species) by pike, tench, roach, rudd, perch and eel, whereas common bream may have been more dominant in the Broads rivers,

thus allowing all of the aforementioned species to co-exist in large numbers. It is clear that, as for macrophytes, the current fish fauna of the broads is a long way away from the ancestral communities that anglers encountered in the past. To return the Broads to its angling and ecological heyday, lake restoration is urgently needed.

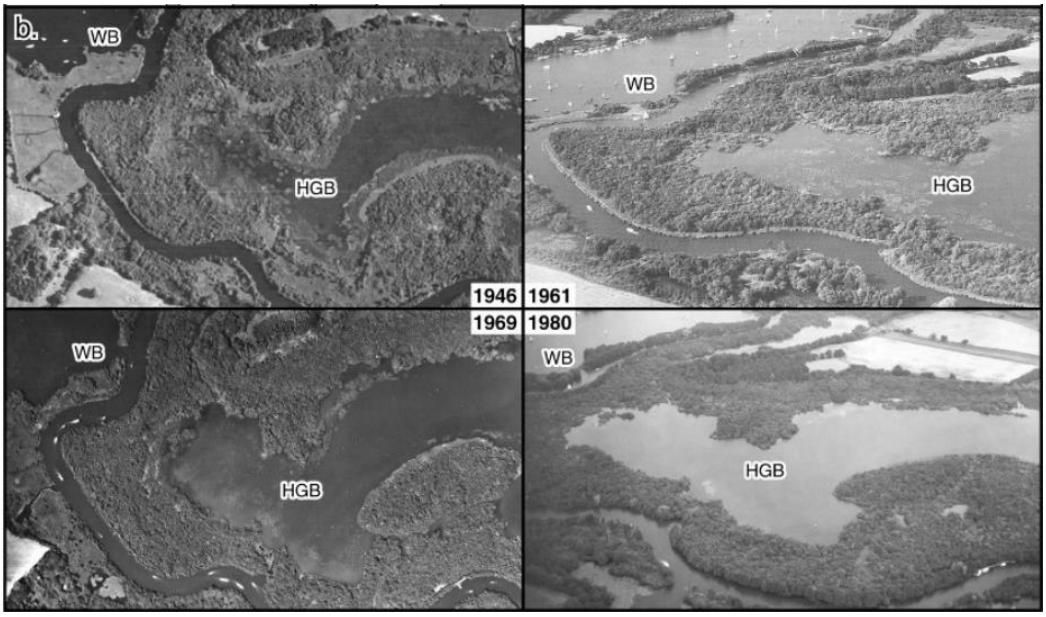

Figure 1. Historical changes in the aquatic vegetation of Hoveton Great Broad 1946-1980 as seen from aerial photographs (from Sayer *et al.,* 2006).

Value of undertaking biomanipulation at Hoveton Great Broad

While there are complexities, exceptions and unanswered questions associated with all internal "lake-centred" shallow lake restoration techniques, a clear and emerging pattern is for a lack of long-term and sustained recovery of lakes, unless successful external nutrient reduction has been undertaken (Sayer *et al.,* 2019). Biomanipulation is the most fully studied internal lake restoration measure and many parallel, multi-decadal studies, suggest that positive lake recovery only occurs where nutrient concentrations have been appropriately reduced (below around 50 μg/L for total phosphorus), or where fish manipulations are regularly repeated, such that the zooplanktivorous fish stock is permanently held in check (Jeppesen *et al.,* 2012). It is clear, therefore, that the key to sustainable restoration success in nutrient-enriched shallow lakes, including biomanipulation, is effective accompanying external nutrient reduction. In the case of Hoveton Great Broad, much necessary pre-work has been undertaken. Nutrient concentrations in the River Bure in the area close to Hoveton are now relatively low (total phosphorus <60-70 μg/L) and sediments have been removed from the lake, which may have reduced sediment-release of phosphorus to the lake water. Hoveton Great Broad is therefore in the kind of situation where biomanipulation has a high chance of being effective in tipping the balance towards the return of aquatic macrophytes, with enormous associated conservation and fisheries benefits. Alternatively, if biomanipulation is not undertaken there is a strong chance that, in a deeper broad (due to sediment removal), the water may remain stubbornly turbid, leading to a failure of the restoration project. There are other examples of sediment-removal failing to lead to the return of clear water, macrophyte-dominated conditions (e.g. Burntfen Broad, Norton's Broad) and it would be a tragedy to see Hoveton Great Broad go the same way, especially after so much expense.

A personal note

Please note, that the key to the long-term recovery of Hoveton Great Broad and indeed the Bure Broads in general, both as a wild habitat and as a fishery will be further nutrient reduction and if this can be achieved, via additional improvements to sewage treatment and importantly major changes to farming practices in the catchment, the system will no doubt recover. To get to this situation will require much lobbying to achieve necessary changes to policy and practice and in this I urge anglers and conservationists to unite in a fight against increasing catchment development and current all to regular upstream farm-derived pollution events. I am both a life-long angler and a passionate conservationist and I see no separation in these things. I can acknowledge both sides of the Hoveton argument and I am of the view that fish tend to get the rough end of the stick from a conservation perspective. However, we need to aim for a much healthier Broads ecosystem and fishery where tench, rudd, perch, pike and indeed eels, all of which are far less common than they used to be, are able to thrive like they once did. These fish will also provide wonderful angling opportunities and of course, as is evident from the historical literature covered above, common bream will still likely be present and abundant in an overall improved Broads aquatic environment. To not finish off the Hoveton Great Broad restoration work by cancelling the proposed biomanipulation would probably be the wrong thing to do, given the current ecological situation.

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Carl Sayer, April, 2021