Translocation of a nationally scarce aquatic plant, grass-wrack pondweed *Potamogeton compressus*, at South Walsham Marshes, Norfolk, England

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SUMMARY

To mitigate for loss of a dyke supporting a population of the nationally rare grass-wrack pondweed *Potamogeton compressus* due to be infilled during flood defence works, a new section of dyke was excavated. Grass-wrack pondweed turions were collected prior to infilling of the old dyke and grown on, both indoors and outdoors, for transplanting into the new dyke once completed. The pondweed was also present within adjoining dykes potentially at risk to increased turbidity/siltation and/or water pollution, plus hydrological changes during construction works. Therefore, to reduce these risks, measures were implemented, including bunding of internal dykes and installation of 'silt curtains' to minimise such impacts. Finally, as the old dyke was infilled, the majority of the green material was removed by hand using grapnels, and sections of silt (including turions) where the plant was growing were sequentially removed mechanically and placed into the adjacent new length of replacement dyke. Monitoring of the new dyke in 2007 and 2008 (one and two years after creation) indicated successful grass-wrack pondweed establishment; in 2007 it was the dominant taxa. In 2008 its density was lower, however cover of other aquatic species had significantly increased. The results are consistent with those of another translocation, where good populations were present during the first 2-3 years of establishment, with populations tailing off as the new habitat is colonised i.e. the species is considered a primary coloniser.

BACKGROUND

The Broadland Flood Alleviation Project (BFAP) is a long-term project to provide a range of flood defence improvements, maintenance and emergency response services within the tidal areas of the Rivers Yare, Bure, Waveney and their tributaries in Norfolk, eastern England. Broadland Environmental Services Ltd. (BESL), a joint venture between Halcrow Group Ltd. (design and environment) and Edmund Nuttall Ltd. (contractor), has been appointed by the Environment Agency to deliver an integrated 20 year programme of flood risk management to over 250 km of flood defences, based on design solutions that are technically, economically and environmentally acceptable i.e. 'sustainable'.

In 2005, BESL commenced detailed design for flood defence improvements to a section of the right hand bank of the River Bure, known as BFAP Compartment 2 (South Walsham Marshes). Baseline environmental surveys recorded the presence of grass-wrack pondweed *Potamogeton compressus* (a nationally scarce species) in the local dyke system, including a section within the works corridor (known as a "soke dyke"). The improvement works, programmed to start in April 2006, required the in-filling of the existing soke dyke and the excavation of a replacement one. This would result in the loss of part of the pondweed population. Although there would be no direct impact on the remainder of the population in the adjoining marsh dykes, thereby offering a source of natural spread into the new soke dyke, it was

felt that mitigation measures were appropriate because:

i) a relatively large proportion of the total population would be lost;

ii) there was potential for the whole population to be indirectly affected by turbidity or pollution;

iii) this is the only extant population in Norfolk.

Grass-wrack pondweed is a submerged linear-leaved freshwater macrophyte, associated with still or gently flowing calcareous, mesotrophic waters; it requires good quality, clear water, with only a limited amount of emergent vegetation cover. It is a nationally scarce plant, considered 'Endangered' in Britain (Cheffings & Farrell 2005), and is a UK and local (Norfolk) Biodiversity Action Plan species. The main reasons for the species decline in the UK are considered to be eutrophication, boat traffic, and the shallowing or drying out of canals and ditches (Cooper 2002). However, recent surveys indicate the decline is less severe than previously thought, as it is a mobile species, often persisting no more than 15 years in a site; rates of colonisation seem approximately the same as loss. Whilst it has never been common, at the best sites the species has been recorded for centuries (Lockton 2008). Recent records indicate populations are now concentrated in central England, the Welsh borders and Norfolk; it has also been recorded from Scotland. Within Broadland the species is confined to mesotrophic grazing marsh dykes, and is known from only two localities (Cooper 2002). In addition to eutrophication and inappropriate dyke management, saline inundation is a potential threat to the species within Broadland due to its location within embanked grazing marshes adjacent to tidal rivers.

ACTION

A number of mitigation techniques have been developed by the BFAP for the protection and/or re-establishment of notable species[1] as well as the protection of other features, such as wind pumps. Details can be found on the Project's website: www.bfap.org. A Mitigation Practice Note for grass-wrack pondweed (Halcrow 2006) was produced as part of the planning proposals and submitted to Natural England for approval. The mitigation comprised six stages.

Turion collection: At the end of the growing season in October 2005, 100-150 turions from senescing plants were collected. These were stored in freshwater in refrigerated dark conditions, over the winter of 2005/06. Turions (reduced branches) are 'hibernaculae' (i.e. over-wintering organs), which grass-wrack pondweed uses for propagation of new plants rather than seeds that are only produced sparingly. Turions, up to 60 mm in length and 3-8 mm wide, begin to develop in late June, before the plant senesces in the autumn. They over-winter in the sediment before germination is triggered by increasing temperature and light in the spring (Cooper 2002).

2006 donor dyke seeding: In spring 2006, 20 to 30 of the turions were transferred to an existing, recently created dyke in adjacent Upton Marshes. The location was in an area managed by the Norfolk Wildlife Trust and adjacent to the Upton Broad and Marshes Site of Special Scientific Interest.

Laboratory propagation: Approximately 50 plants were grown in two batches under laboratory conditions in spring and summer 2006, within a temperature and light controlled growth cabinet. The methods used were based upon those of Cooper (2002) and Birkenshaw and Kemp (2006), and are described in Halcrow (2007). Turions were placed in small plastic pots filled with aquatic compost and lined with jute netting to retain intact root balls upon transplantation (Fig. 1). The pots in turn were placed in freshwater aquaria within the growth cabinet. The first batch of plants was grown by mid-summer, so had their turions removed for storage in the refrigerator and placement in the new dyke in spring 2007. The second batch of plants was mature by September. These were transplanted as whole plants into the newly created dyke habitat in September 2006.

Figure 1. Planted turion ready for placement in growth cabinet, spring 2006.

Outdoor propagation: Using similar principles to those described for the laboratory propagation but on a larger scale, propagation from turions using large plastic barrels was undertaken over the summer of 2006. Approximately 40 plants were grown on using this technique. Growth was much more dense and luxuriant in comparison to laboratory propagation, and plants produced a small number of flowers and fruit in addition to numerous turions. Senescence commenced from July 2006 onwards. Plants were left undisturbed until September 2006, at which time the numerous turions (and two fruit) were removed, transported to the new soke dyke and placed in the water to settle.

Protection of existing adjoining population: In addition to the soke dyke, grass-wrack pondweed was recorded growing within the adjoining marsh dykes (Compartment 2) which would not be directly affected by the construction works. However, potential indirect impacts included water quality (turbidity/siltation and/or water pollution) and hydrological changes to the site's drainage. Standard BFAP pollution prevention measures were implemented, including bunding of internal dykes to prevent turbidity impacts from soil movements; at the request of Natural England additional measures were put in place to protect the adjacent population during bund construction. Turbidity and siltation impacts resulting from bund creation were limited by the installation of 'silt curtains'. These comprised a geotextile membrane, with bricks used to provide a weighted hem (Fig. 2). Curtains were staked either side of the bund location, to act as a physical screen protecting the adjoining marsh and soke dyke populations whilst the bund was constructed (Fig. 3). It was noted during August 2006 that grass-wrack pondweed was growing out of the side of one of the bunds.

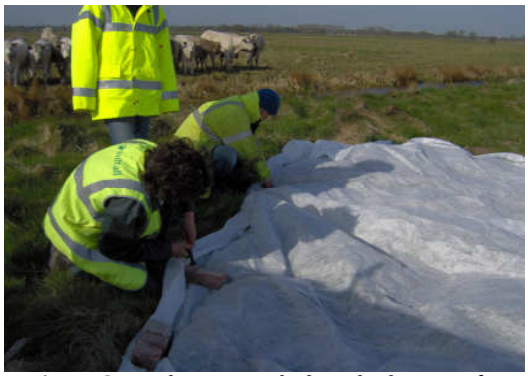

Figure 2. Bricks are attached to the bottom of a geotextile membrane to provide a weighted hem to a 'silt curtain', spring 2006.

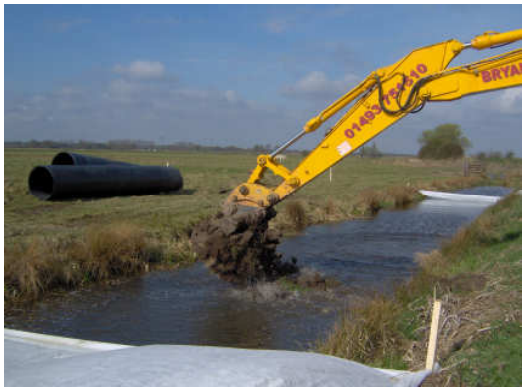

Figure 3. The curtains are secured into place either end of the bund location to limit movement of turbid water during construction, spring 2006.

Transfer of silts and plant material: Steel piling used to subdivide existing soke dyke habitat as works commenced to infill the dyke in August 2006 (Fig. 4). The final stage of the mitigation related to the method of work used to infill the section of the old soke dyke where the plant was growing and construct the adjacent new length of replacement dyke. This enabled plant material to be sequentially removed from subsections of the old dyke to subsections of the new dyke. The majority of the green material was removed by hand using grapnels. Approximately 25% of turions on the plant material were removed for storage in a refrigerator over winter, with the remaining material placed immediately into the new dyke. Silt (including turions) was transferred mechanically between the old and new dyke habitat (Fig. 5). These construction works were undertaken in the third week of August 2006. The new dyke habitat was allowed to settle before plants from both the laboratory and outdoor propagation exercises were relocated in early September 2006.

The final transfer of plant material comprised the placement of turions into the new dyke habitat in spring 2007, using the material generated from the first batch of laboratory propagation in 2006 and collected from the existing population in August 2006, which had been stored over winter in the refrigerator.

Figure 4. Steel piling used to subdivide existing soke dyke habitat as works commenced to infill dyke, August 2006.

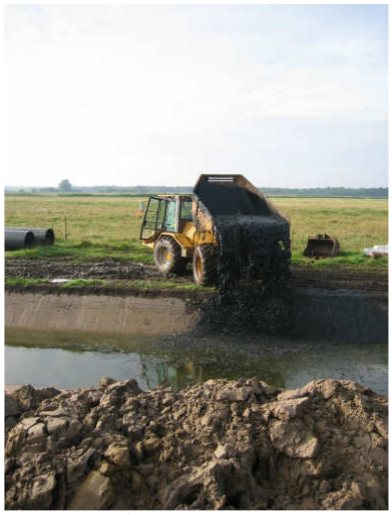

Figure 5. Silt from the old soke dyke (containing pondweed turions) placed into new dyke to act as inoculate, August 2006.

CONSEQUENCES

Monitoring has been undertaken on a regular basis since 2006. Initial observations of the donor dyke in the adjacent Upton Marshes suggested the presence of a single plant growing in 2006. This was not surveyed with a grapnel at the time due to the physical damage which would result. No plants have been recorded growing in the donor dyke during 2007 or 2008.

Monitoring of the new soke dyke in 2007 (Halcrow 2007) and 2008 indicates successful establishment; in 2007 grass-wrack pondweed was the dominant taxa in the section of new soke dyke (Fig. 6), dense in some locations, but relatively dispersed in other areas i.e. relatively high open water cover. In 2008 the density of the plant was relatively low throughout its distribution in the newly created dyke; however cover of other species (including other pondweeds, charophytes and milfoils *Myriophyllum* spp.) was significantly increased. Growth of grass-wrack pondweed to the west of the old pumping station had increased in extent in comparison to 2007. In the adjoining marsh dykes the plant was recorded extensively in both 2007 and 2008 surveys, with slight variations in density and location of cover between years. Due to time limitations the southerly extent of the species distribution within the South Walsham Marshes was not established during either survey.

The results from this study are consistent with those reported from a translocation exercise undertaken by British Waterways, where good populations were present during the first two to three years of establishment, with populations tailing off as the new habitats were colonised i.e. the species was considered a primary coloniser (further information is provided on the BSBI website: www.bsbi.org.uk/html/potamogeton compressus.html). Such colonisation patterns are consistent with the described nature of the plant (Lockton 2008); natural habitats include places, such as the upper floodplains of rivers and the outflow streams of mesotrophic lakes, where clear and open conditions are maintained. In modern times canals and drainage ditches have fulfilled such roles, although may be subject to succession and not, therefore, able to sustain populations in the long term.

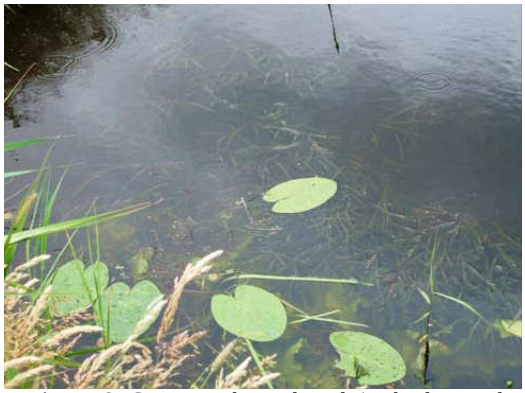

Figure 6. Grass-wrack pondweed (with elongated submerged leaves) growing in the new dyke, June 2007.

The dykes in the South Walsham Marshes comprise part of the main drainage channel, and therefore sustain a low level of flow. Using a species specific management plan, the dykes are managed by the Broads Internal Drainage Board (Water Management Alliance) to maintain a relatively open channel, conditions presumably important for the species persistence in the area. As the newly created habitat will be subject to the same management in the longer term, it is hoped that the population will persist in the new soke dyke, maintaining the stability of the small Norfolk population.

[1]These include a range of species with statutory protection (e.g. water vole *Arvicola terrestris*, common lizard *Lacerta* (*Zootoca*) *vivipara*) as well as those that are covered by UK/local BAP (e.g. greater water parsnip *Sium latifolium*) or may 'just' have some local value (e.g. marsh mallow *Althaea officinalis*).

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