THE PLANT LIFE OF DITCHES ON THE LEVELS

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Abstract

Ditches are the most numerous waterways on the levels. They represent a classic example of ecological succession, ranging from open water in a newly cleaned ditch, to initial colonisation by aquatic plants and marginal species from the banks, through a diverse and species-rich aquatic community, to finally, marsh, alder/birch/willow carr and woodland. The characteristic plant species of the ditches, including the floating, submerged and emergent aquatics and the marginal species, are considered, as well as the processes of succession and life cycle and the habitat requirements of the individual species and communities. The effects of both traditional management of the ditches and modern techniques are looked at in relation to their effects on the ditch community.

INTRODUCTION

The Somerset Levels and Moors are one of Britain's largest remaining wet meadow systems. They are of international importance for birds and wet meadow flora and are one of the best sites in Britain for meadow plants. The rivers, rhynes and ditches have a two-fold function – as drainage ditches in the winter to carry flood waters away and as a ready supply of water in the summer for 'wet fences' and drinking water for grazing animals. Most of the rhynes and ditches originate from the time of the Enclosures of the late 18th and 19th centuries (English Nature 1997). The ditches are the most numerous watercourses on the wetlands, one square mile of the moorland contains 20 miles of ditches (Storer 1985). They are generally about 0.9–1.2m wide. The amount of open water varies according to the time since the ditch was last managed. More recently cleared ditches will be wider with the older ditches having a greater abundance of marginal and aquatic plants causing the amount of open water to be reduced. Another important factor is the amount of rainfall.

DITCH SUCCESSION

The classic ecological wetland succession can be observed by examining ditches at various stages of development. Bernard Storer in his classic work on the Natural History of the Somerset Levels, categorised the ditches into four types, according to the amount of time that had passed since they were last cleaned out and the amount of open water that was still present. Starting with a newly cleared ditch, we observe an open water community with few aquatic plants and banks which have generally been cleared of vegetation. As the ditch community develops in a recently cleaned ditch, aquatic plants are carried by water currents and animals into open water, and sedges, rushes and reeds grow in from the sides of the ditch. As the aquatic plants die off in the autumn and winter months, their remains sink to the bottom of the ditch. Organic matter builds up so the middle-aged ditch becomes shallower and narrower and the amount of open water is reduced to around 50% that of a newly cleaned ditch. The ditch can become completely overgrown in 4–6 years in the absence of intervention management. Bernard Storer classified a ditch as old if less than 25% of the original surface remained open. If the natural

succession is allowed to develop the climax community will be wet woodland.

The SSSI Guidelines (NCC 1989) describe the succession from open water to dry land as the hydrosere according to the Margaret Palmer Classification of ditch types (Palmer 1989). This is a broad classification of ditch vegetation communities using chemical data (conductivity measurements) as well as the ditch width and depth, the amount of open water present, and the cover of characteristic species such as the duckweeds, and the amount of emergent vegetation present.

FLOATING AQUATIC PLANTS

The floating aquatic plants tend to be the early colonisers of the open ditches. These species can be swept in from connected ditches or regenerate vegetatively from the plant fragments that remain after ditch cleaning. Grazing stock such as cattle may also bring new plants into a ditch on their feet, when they come to drink. The duckweeds *Lemna* spp. are the most common plants in this group of floating aquatics, and they often form a dense, free-floating carpet over the entire surface water of the ditch. Common Duckweed *Lemna minor* is substantially the most common plant in the ditches. It occurs throughout the ditch cycle but is less abundant in older ditches due to less availability of open water surface. Fat Duckweed *Lemna gibba* tends to be found in the more sluggish nutrient rich waters and it is often found with Common Duckweed. Both these species have only one root, but Fat Duckweed is usually strongly swollen on the lower side, whereas common duckweed is flat on both sides. Greater Duckweed *Spirodela polyrhiza*, formerly *Lemna polyrhiza*, is much larger than the other two duckweeds and can be up to 10mm across. The underside of the plant is flat and is purplish-green in colour and it has many roots as its name suggests. The average is around 21 individual roots, according to Clive Stace (Stace 1997). As well as its leaves sinking in winter, it also produces specialised winter buds or turions, which do not open but break off in the autumn and sink to the bottom of the ditch. In spring, they develop and rise to the surface. Many of the floating aquatic plants have adopted this survival strategy of rapid growth in the summer and sinking to the bottom in the cooler months to lie dormant until the next growing season.

Greater Duckweed has a more localised distribution than the other duckweed species on the Levels, as it tends to be associated with unpolluted, unshaded clear waters. It is therefore found in the more open ditches where it forms an important part of a diverse ditch community with the other duckweeds, frogbit and often a diverse mix of submerged aquatic plants (English Nature 1997). Ivy-leaved Duckweed *Lemna trisulca* is different from the other species of duckweed as it has spear-shaped leaves and floats below the surface of the water. This plant can become very dominant in a ditch, once established. It is vulnerable to the presence of the surface duckweeds which deprive it of light. Least Duckweed *Lemna minuta* is a very small plant and occurs in the same habitats as common duckweed. It is described in the Atlas Flora of Somerset (Green *et al*. 1997) as an increasing species in the county and especially common on the Levels. It may have been overlooked in previous surveys. Rootless Duckweed *Wolfia arrhiza* is a small plant and is easily overlooked early in the season but in late summer and autumn it can become very abundant. It has no roots and is usually found floating on the water surface. It tends to be strongly swollen on both sides and so is thicker than it is wide. The stronghold for this nationally scarce plant in Britain is on the Levels (Green *et al*. 1997).

Another plant frequently occurring with the duckweeds is Frogbit *Hydrocharis morsus-ranae* (Fig. 1). The main stems form floating stolons or runners, which can reach considerable lengths (up to 0.5m but can be up to 1m). This plant, like many of the floating aquatics, forms over-winter terminal buds in the autumn which drop off and sink. The 3-petalled flowers are white with a yellow blotch on the petals. This plant has shown a decline in its distribution. It prefers still to slow water generally with a high alkalinity. It prefers unpolluted waters which may be a reason behind its decline, as the

Fig. 1 Frogbit *Hydrocharis morsus-ranae*

nutrient status of the ditches increases due to run-off from fertilised fields.

The species described above form characteristic communities associated with the earlier stages of the ditch clearance cycle. These plant communities are described within the National Vegetation Classification (Rodwell 1995), a classification system for all the vegetation types of the British Isles based on a standardised sampling technique.

More unusual floating aquatic plants are the bladderworts. The Greater Bladderwort *Utricularia vulgaris* (Fig. 2) is the one that is found most frequently on the Levels, although the Lesser Bladderwort *U. minor* is also present. These plants trap small water creatures, typically the size of the water flea *Daphnia* spp. in small bladders which work with a trap door action, triggered by an animal touching the tiny hairs on the outside of the trap door. The Greater Bladderwort is found in deeper water in more alkaline conditions whereas the Lesser Bladderwort is associated with the more acid ditches of the peat moors.

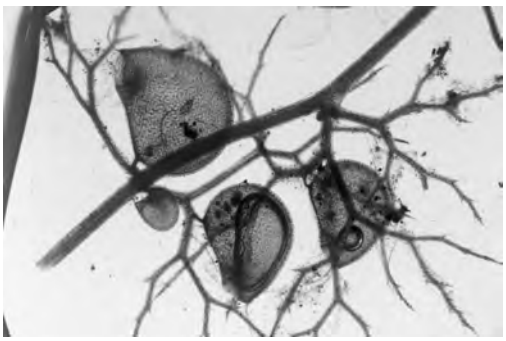

Fig. 2 Greater Bladderwort *Utricularia vulgaris*

The blanket weeds (Chlorophycaea) are another significant component of the flora of the ditches and can become very abundant, smothering out the other aquatic plants. However, they are eaten by many of the smaller invertebrates found in the ditch and offer some shelter and protection to these smaller animals from predators, such as fish.

SUBMERGED AQUATIC PLANTS

Examples of this group are the pondweeds *Potamogeton* spp. and the starworts *Callitriche* spp. They can both be difficult groups to identify and the pondweeds have their own Botanical Society of the British Isles (BSBI) volume to aid with identification (Preston 1995). One of the difficulties of the pondweeds is that some species have both submerged and floating leaves which are morphologically different. The submerged leaves tend to be long and narrow whereas the floating leaves are generally broader. Many aquatic plants show this divergence of leaf morphology allowing them to function and carry out photosynthesis efficiently at a range of different water levels. The aerial leaves are generally photosynthetically inefficient when submerged and so the underwater leaves tend to have long, thin, flexible and finely divided foliage. The Fennel Pondweed *Potamogeton pectinatus* is the commonest pondweed on the Levels (Green *et al*. 1997). This plant has a slender appearance with very long, narrow submerged leaves ranging from bright green to olive green (Preston 1995). This species has no floating leaves and tends to occur in more middle-aged to old ditches. Eleven species of pondweeds have been recorded on Sedgemoor according to Storer (1985). Shining Pondweed *Potamogeton lucens*, a submerged aquatic species, is generally found in the larger rhymes. One rare species, the Fen Pondweed *Potamogeton coloratus* (nationally scarce), found in the rivers, rhynes and ditches, is a species of high conservation importance and has a restricted distribution in the UK (English Nature 1997). It is generally a species of shallow, calcareous water, usually less than 1m deep (Preston ,1995). This species has more or less translucent leaves with a conspicuous venation.

The Common Water-starwort *Callitriche stagnalis* can usually be separated from the other members of this difficult genus and is generally a widespread species (Fig. 3). Other species such as Various-leaved Water-starwort *C. platycarpa* and Blunt-fruited Water-starwort *C. obtusangula* are only frequent or common on the Levels. In the Common Water-

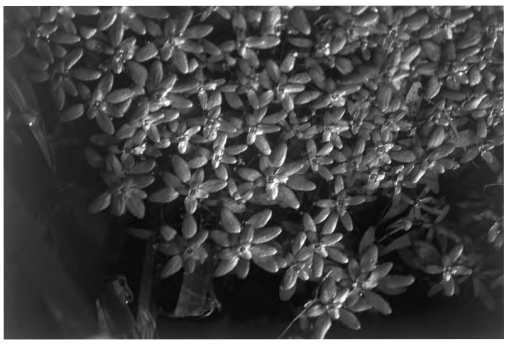

Fig. 3 Common Water-starwort *Callitriche stagnalis*

starwort, the submerged leaves are narrowly elliptic whilst the floating leaves tend to be broader, forming a terminal rosette which gives the plant its name. The water-starworts can be distinguished from other aquatic plants by the opposite, thin, narrow, often notched leaves, single stamen and distinctive fruits (Stace 1997).

Of the two common pondweeds – Canadian Pondweed *Elodea canadensis* and Opposite-leaved Pondweed *Groenlandia densa* – Canadian Pondweed is an introduced species first recorded in 1836 and is now very common throughout the British Isles. Opposite-leaved Pondweed is a native species and, as its name suggests, its leaves are all opposite whereas in Canadian Waterweed the leaves generally occur in whorls of three. This rule has to be used with caution as the lower leaves of Canadian Pondweed are opposite and *Groenlandia* can, rarely, have some leaves in whorls of three (Stace 1997). Nuttall's Waterweed *Elodea nuttallii* is an introduction which was first reported in the county in 1976 in the Bridgwater and Taunton Canal (Green *et al*. 1997). This species is now common on the Levels and often grows with Canadian Pondweed and can be distinguished from this species by its longer, narrower and more pointed leaves.

The Water Fern *Azolla filiculoides* is a floating rather than a submerged aquatic species and it is the only floating fern in Britain. It is also an introduced species which is only locally common on the Levels in Somerset (Green *et al*. 1997). Its abundance tends to fluctuate from year to year as it is very susceptible to severe weather conditions. With the onset of global warming, perhaps we should expect to see more of this little plant. The fronds are made up of many tiny over-lapping leaves. The water milfoils *Myriophyllum* spp can be a difficult group of plants to distinguish and the three native species are Whorled Water-milfoil *M. verticillatum*, Spiked Water-milfoil *M. spicatum* and Alternate Water-milfoil *M. alterniflorum*. The Spiked Water Milfoil is the species most likely to be encountered in the ditches and watercourses of the Levels. It is characterised by its pigmented stems and rigid leaves (Rich and Jermy 1998). The alien species Parrot's Feather *Myriophyllum aquaticum*, is not common on the Levels and does not tend to persist very long due to our harsher winter climes. Mare's-tail *Hippuris vulgaris* is a submerged aquatic species but the top, flower-bearing part is usually held above the water's surface.

The Water Violet *Hottonia palustris* (Fig. 4) is described in the Atlas of Somerset as locally common on the Levels but rare on a county basis. Even in its stronghold, it is suffering a decline as once ditches become overgrown and clogged with vegetation, it disappears. Like Mare's-tail, this species has its vegetative parts comprising bright green whorls of strongly divided submerged leaves, and only the delicate, violet-like flower is borne above the water surface. The submerged leaves may be confused with water milfoils at first glance. Of the water crowfoots, the Common Water Crowfoot *Ranunculus aquatilis* is the commonest species and has differentiated submerged and floating leaves. The submerged leaves are very finely divided and the floating leaves are broadly lobed. The other two species which are frequent on the Levels and now virtually confined to this area in Somerset (Green *et al.* 1997) are the Fan-leaved Water Crowfoot *R. circinatus* and Thread-leaved Water Crowfoot *R. trichophyllus*. Both of these species have finely divided aquatic leaves and the leaves of *R. circinatus* are very distinctive, being short and rigid with the different segments held in a single plane, like the spokes of a wheel (Rich and Jermy 1998).

Fig. 4 Water Violet *Hottonia palustris*

EMERGENT AQUATIC PLANTS

This group of aquatic plants carry most of their leaves and flowers above the water. They tend to arrive later on in the ditch succession and would have dominated the Levels before modern drainage schemes came into being (Storer 1985). Water Plantain *Alisma Plantago-aquatica* is a common plant in the ditches and grows to 1m in height. Its relative, Narrow-leaved Water Plantain *Alisma lanceolatum* is also widespread. In Somerset, both these species are frequent in abundance. The two plants can be distinguished by leaf-shape but are more easily separated when in flower. Stace (1997) has suggested

that Water Plantain flowers open in the afternoon whereas Narrow-leaved Water Plantain flowers open in the morning, but this characteristic is questioned (Rich and Jermy 1998). Arrowhead *Sagittaria sagittifolia* (Fig. 5) and Flowering Rush *Butomus umbellatus* are very distinctive emergent aquatic plants when in flower. Again, both these species are widespread on the Levels but rare elsewhere in Somerset. A much rarer species is the Lesser Water Plantain *Baldellia ranunculoides* which tends to be found more often in rhynes and wet fields and has suffered a decline in recent years (Green *et al*. 1997).

Fig. 5 Arrowhead *Sagittaria sagittifolia*

Three of the four British bur-reeds are found on the Levels. These are the most common species – Branched Bur-reed *Sparganium erectum*, Unbranched Bur-reed *Sparganium emersum* (Fig. 6) and Least Bur-reed *Sparganium natans*. The latter is found only in a small peat cutting on Street Heath (Green *et al*. 1997) where it was introduced, and where its survival is precarious. The bur-reeds are very difficult to identify from vegetative material but when they are in flower or fruit they are distinctive.

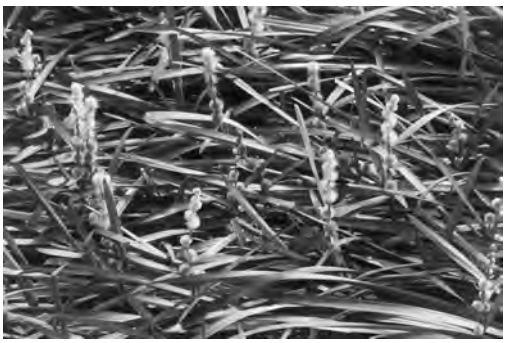

Fig. 6 Unbranched Bur-reed *Sparganium Emersum*

The Lesser Water Parsnip *Berula erecta* is relatively common and can become abundant in some watercourses. This species is distinguished from the commoner Fool's Watercress *Apium nodiflorum* by the ring-mark on the stem below the lowest pair of leaflets (Stace 1997). Greater Water Parsnip *Sium latifolium* is a rare plant, nationally classified as scarce, which may have been over-recorded in the past as *Berula erecta*. It is only found on the Levels (Green *et al*. 1997). Watercress *Rorippa nasturtium-aquaticum* is also a frequent plant of the ditches, anecdotally associated with sewerage and old cess pits (Storer 1985).

MARGINAL SPECIES

There is no clear ecological dividing line between the emergent aquatic plants and those which tend to occur on the margins of the ditches and are also strongly associated with periodically flooded land and wet grasslands. The sedges and rushes are included in the marginal category as they tend to occur, or at least begin their colonisation of open water, at the margins of the ditches. Both the emergent aquatics and the marginal species such as the sedges and rushes make up the bulk of the swamp, water-margin vegetation and tall-herb fen communities described in the National Vegetation Classification (Rodwell 1995). The distribution and frequency of occurrence of both the aquatic and swamp, water-margin and tall-herb fen communities have been described in detail for North Moor and Southlake SSSIs by Hughes (1995).

Reed Canary Grass *Phalaris arundinacea*, Reed Sweet-grass *Glyceria maxima* and the Common Reed *Phragmites australis* were the most common tall reed-like species recorded in Bernard Storer's ditch survey. All of these species produce considerable litter which accumulates and tends to build up in the ditches so playing an important part in the ecological succession from open water to terrestrialisation. Nine different species of rush occur on the Levels (Storer 1985), including the common Soft Rush *Juncus effusus* and Jointed Rush *J. articulatus*. Over 30 different species of sedge (*Carex* spp.) have been recorded from the Levels (Storer 1985), mostly from the wet meadows and peat moors. More aquatic sedges tend to be most abundant in the older ditches. The commonest species associated with the ditches are the Greater Pond Sedge *Carex*

riparia and Lesser Pond Sedge *C. acutiformis*, generally forming an important part of the marginal vegetation of most ditches. Although the size of the leaf is frequently used to distinguish between these two species, the species are best separated when in flower (Rich and Jermy 1998).

EFFECTS OF DITCH MANAGEMENT

The maintenance of the field ditches is the responsibility of local farmers except in two Drainage Board Areas, and the type and frequency of management obviously has a significant effect on the type and diversity of plant species present. The most diverse ditches are generally not those that are maintained on an annual or bi-annual basis as intensive management will reduce their biodiversity. After cleaning or dredging, the ditch community develops, if left undisturbed, first to a generally algae-dominated community, then to an open-water community with both floating and submerged aquatic plants, through to a community where emergent species are dominant. In a mature or middle-aged ditch, the plants which need open water, or true aquatics, can survive in the centre of the ditch and those which require marshy conditions thrive on the edges and ditch banks. Intensive management or pollution may hold back the natural ditch succession and keep it in the phase which is dominated by algae and perhaps a few floating aquatic plants. Ditch cleaning returns the ditch community to an earlier stage of the succession. It is highly likely that introduction of mechanical clearance has resulted in the decrease and perhaps loss of some vulnerable species. Ditch cleaning is now rarely carried out manually and dredgers complete the job more quickly. Water quality is also an issue and in some watercourses has more than likely reduced the diversity of aquatic plants and animals. Also, the traditional practice of lowering water levels during the winter can have an adverse effect on the flora and fauna of the ditches (English Nature 1997).

CONCLUSION

Ditches are essentially a man-made feature of the Levels. They undergo a natural succession which leads to the development of a rich flora and fauna which changes throughout the ditch cycle. The change from traditional management techniques of hand clearance, which tended to be less disruptive to the developing ecosystem, has resulted in the ditch succession now having only a few years to complete. This has resulted in the loss of some of the richer ditch communities which can now only been seen on protected areas. This illustrates the importance of the area as a very special site for our wetland flora.

ACKNOWLEDGEMENT

The author would like to thank Graham Rix, Somerset Wildlife Trust volunteer warden for Street Heath, for providing the photographic material for this paper.

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