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MANAGEMENT/UTILIZATION

The Influence of Vegetation Pre-dredging on the Post-dredging Community

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ABSTRACT

Vegetation present in a channel immediately before it is dredged was found to have a significant influence on the post-dredging vegetation in terms of species composition. Approximately 60% of the species recorded prior to dredging were found in the first 2 yr after dredging. Mean cover values of species indicative of the latter stages of channel hydroseral succession (*e.g.* great pond-sedge (*Carex riparia* Curtis) and common reed (*Phragmites australis* (Cav.) Trin. ex Steudel) are much less in the post- than in the pre-dredging channel. The most important elements of post-dredging vegetation were filamentous algae and floating species such as common duckweed (*Lemna minor* L.), fat duckweed (*L. gibba* L.) and frogbit (*Hydrocharis morsus-ranae* L.). These species were present before management but only with small percentage cover. Although no submerged species was recorded pre-dredging, a number of such species did appear in channels post-dredging but they did not persist.

Key words: drainage channel, colonization, succession, Gwent Levels.

INTRODUCTION

The management of aquatic vegetation is typically dependent upon a single disruptive act such as a weed cut or the application of a herbicide designed to reduce the biomass of that vegetation for a significant period of time. The period of satisfactory control is dependent upon a number of factors, one of which is the rate of re-colonization of the habitat by aquatic vegetation. This re-colonization can be due to new species moving into the habitat or to the recovery or persistence of species present in the habitat before the management event. The movement of species into a water body has received some attention in the past beginning with the observations of plant ecologists such as Godwin (1923), though neither process has been investigated in any detail. Dredging is one of the most extreme forms of aquatic plant management, an event which is intended to remove not only all plant material but also accumulated sediments. This investigation was designed to determine whether the vegetation in a drainage channel immediately before it was dredged-out had any effect on the composition and development of the flora after dredging.

MATERIAL AND METHODS

Subsidiary channels of the Gwent Levels, South Wales, were chosen for the project, typically 2.6 m in width at water surface with a mean water depth before dredging of 23 cm, and a maximum sediment depth of 72 cm. Post-dredging, these values rose for the water depth (78 cm) and decreased for the sediment depth (19 cm). The drainage system of the Gwent Levels is described in detail by Scotter *et al.* (1977). A total of 18 subsidiary drainage channels located on the Wentooge Level of the Gwent Levels were identified as due to be dredged-out in the summer of 1984. A single 10-m sampling unit was established for each channel based on methodology described by Wade (1978) and the aquatic vegetation was assessed as percentage cover. Additionally, estimates of water depth and sediment depth were made. None of the channels had been dredged-out for at least 8 yr. Each channel was dredged-out along its entire length by a Priestman Mustang hydraulic dredger in June (5 sites), July (7 sites), September (4 sites) and October (1 site). These channel sites were revisited in June or July of the 2 yr following dredging. On both these latter occasions the aquatic vegetation was sampled as for the first visit. This first visit to the channel before it was dredged is termed the pre-dredging visit and the other two visits the post-1 dredging and post-2 dredging.

One site, the reference site, was sampled using three 10-m sampling stretches. These stretches were visited on a monthly basis for the duration of the investigation to give an indication of the spatial and temporal variation of plant species.

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RESULTS AND DISCUSSION

The dredging operation successfully cleared the vegetation and a significant depth of sediment from the channels such that immediately after dredging the sites were totally devoid of vegetation (Figure 1) except for occasional fronds of common duckweed (*Lemna minor* L.), fat duckweed (*L. gibba* L.), and filamentous algae floating on the surface. The results from the reference site indicate that a single 10-m sample stretch and two visits in the summer per annum are sufficient to accurately record the recovery of a site (Figure 1). Figure 1 also illustrates the uniformity of vegetation along a channel.

The mean number of species in the pre-dredging visits was 10.3 species. At the post-1 dredging visit a mean of 9.6 species had become established rising to 10.3 species by the post-2 dredging visit. Not only was the number of species pre-dredging similar to that recorded after dredging but the vegetation present in a channel immediately before dredging had a profound effect on the vegetation developing within a channel in at least the first 2 yr after dredging.

The post-1 dredging flora contained on average 43% of the species present pre-dredging and the post-2 dredging flora, 50%. Taking the combination of the post-1 dredging and post-2 dredging species complement, 61% of the species present before dredging were recorded in the first 2 yr after dredging.

Those species with a percentage frequency of occurrence in the 17 sites of greater than 50% are ranked in Table 1. Out of a total of 51 species recorded from all three visits from all the sites, 35 were noted in the pre-dredging visit and 38 in the post-dredging visits.

Three species are common to both lists (Table 1), and lesser water parsnip (*Berula erecta* Huds. Coville), tufted forget-me-not (*Myosotis laxa* Lehm.) and great pond-sedge (*Carex riparia* Curtis), though recorded with a less than 50% frequency in post-dredging visits were present at 40%, 40% and 47%, respectively. These recurring species fall into three categories (Table 2):

(a) Species with high percentage cover pre-dredging but with low percentage cover post-dredging, *e.g.* common reed (*Phragmites australis* (Cav.) Trin. ex Steudel), tubular water dropwort (*Oenanthe fistulosa* L.) and great pond-sedge.
(b) Species with low percentage cover pre-dredging but with high percentage cover post-dredging, *e.g.* water-plantain (*Alisma plantago-aquatica* L.).
(c) Species showing no differences between pre- and post-dredging situations, *e.g.* common duckweed, fat duckweed and tufted forget-me-not.

These findings support the description of successional processes in subsidiary drainage channels in which common reed, for example, although a frequent species in recently dredged channels, does not exist in significant stands (>15% cover) until approximately 8 to 10 years after dredging. In contrast water-plantain was present in large stands in recently dredged subsidiary channels but only occurred with low cover values in the older ditches (Wade 1978).

Certain plant species failed to reappear after dredging, for example, lesser marsh bedstraw (*Galium palustre* L.) (13 sites before and only two after dredging); hard rush (*Juncus inflexus* L.) and soft rush (*J. effusus* L.) found in seven and eight sites, respectively, pre-dredging were not subsequently found in any sites. Other similar examples were yellow iris (*Iris pseudacorus* L.) and bittersweet (*Solanum dulcamara* L.)

Taking the reverse case, the most notable plants recorded post-dredging were filamentous algae (Table 1), 12 sites, not found at all pre-dredging. Other submerged marcophytes were recorded only after dredging: *Chara vulgaris* L., rigid hornwort (or coontail) (*Ceratophyllum demersum* L.), pink water-speedwell (*Veronica catenata* Pennell) (submerged form) and lesser pondweed (*Potamogeton pusillus* L.) (Table 3). Filamentous algae and submerged macrophyte species are typically primary colonizers in the hydroseral succession though their duration in subsidiary channels is considered to be short lived, probably only 1 or 2 yr (Wade 1978). This is borne out by the absence of all these species from one or more sites on the second visit (Table 3). A persistent submerged species (*Lemna trisulca* L.) which, although present in sites before management (47% occurrence), increased to 88% in post-dredging sites, a figure sustained for the second visit. Likewise, small pondweed (*Potamogeton berchtoldii* Fieb.) was well established in the reference site 2 yr after management (Figure 1).

The most important element of re-colonization was the floating vegetation, *e.g.* common duckweed, fat duckweed and frogbit (*Hydrocharis morsus-ranae* L.) (Table 2). Other species exploiting this niche were water fern (*Azolla filiculoides* Lam.) and greater duckweed (*Lemna polyrhiza* L.).

Two questions are raised by these observations: did those species appearing apparently for the first time in the sites post-dredging come from propagules already in the sediment and released by the disturbance of management or were they introduced into the site anew? and did all the species which recurred after management survive into the third year and beyond?

Given the ability of a number of plant species as described above to survive such a destructive management regime as dredging, it would not be surprising to learn that other species observed post-dredging, although not present immediately

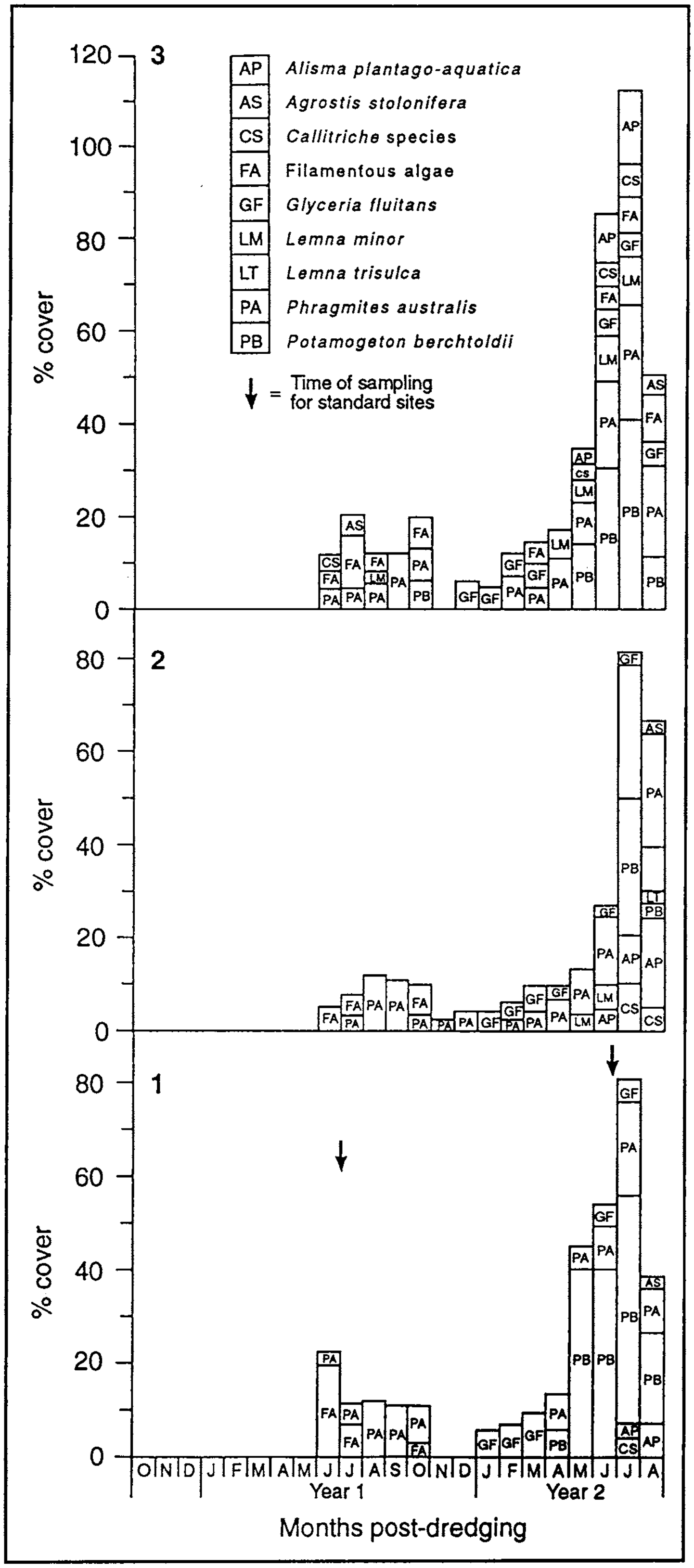

Figure 1. Cover data for species with percentage cover >5% in reference site post-dredging. **1**, **2**, and **3** are the three 10-m sample stretches of the reference site. Dredging occurred in September prior to Year 1.

TABLE 1. SPECIES OCCURRING WITH PERCENT FREQUENCY >50% IN CHANNELS PRE-DREDGING AND POST-DREDGING (post-1 and post-2 visits combined). (Total number of sites = 17).

Species	Pre-dredging	Species	Post-dredging
Phragmites australis	100	*Phragmites australis*	100
Galium palustre	76	*Lemna minor* [1]	94
Lemna minor	71	*L. trisulca*	88
Carex riparia	71	*Hydrocharis morsus-ranae*	76
Oenanthe fistulosa	59	Filamentous algae	71
Alisma plantago-aquatica	53	*Agrostitis stolonifera*	71
Berula erecta	53	*Oenanthe fistulosa*	59
Myosotis laxa	53	*Lemna gibba* [2]	53
		Sparganium erectum	53
		Glyceria fluitans	53

[1]Including the flat form of *L. gibba*.
[2]Excluding the flat form of *L. gibba*.

TABLE 2. MEAN PERCENTAGE COVER OF SELECTED SPECIES PRE- AND POST-DREDGING.

Species	Pre-dredging	Post-1 dredging	Post-2 dredging
Berula erecta	6.5	0.5	2.5
Oenanthe fistulosa	7.0	0.5	1.0
Alisma plantago-aquatica	1.0	8.0	13.0
Hydrocharis morsus-ranae	1.0	3.0	27.0
Lemna minor & L. gibba	15.0	16.0	37.0
Sparganium erectum	1.0	4.0	5.0
Carex riparia	12.0	0	0.5
Phragmites australis	23.0	3.0	5.0

TABLE 3. PRESENCE OF SUBMERGED MACROPHYTE SPECIES THAT WERE NOT PRESENT PRE-DREDGING IN SITES AND POST-DREDGING. (Total number of sites = 17.)

Species	Number of sites	
	Post-1 dredging	Post-2 dredging
Chara vulgaris	5	1
Ceratophyllum demersum	6	5
Veronica catenata [1]	4	2
Potamogeton pusillus	5	2

[1]Submerged form.

before dredging, had been present in a site a number of years earlier. Wade and Edwards (1980) exploring the historical ecology of the Gwent Levels developed just such a hypothesis for species of plants such as *Chara vulgaris* L., a species exhibiting similar distributional patterns elsewhere (Wade 1990).

It has already been indicated that some species, notably the submerged macrophytes, were already in decline in the second year after dredging, presumably due to the dominance of floating species. No doubt other species would also have failed to maintain themselves beyond the second year after management.

Thomas, Allen and Grose (1981) found that removal of reed sweet-grass (*Glyceria maxima* (Hartm,) Holmberg) by dredging from drainage channels on the Ouse Washes, U.K., produced a habitat suitable for a range of colonizing species. They considered that propagules dormant in the mud can be brought to the surface, where suitable conditions for growth may be more likely, thus accounting for a higher floral diversity in channels 1 to 2 yr after dredging compared with the diversity at other times.

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