

Experiment to see whether pondweeds would grow in a pond at Abbey Farm if sediments are removed and cattle and wildfowl are excluded

Background

During the last 40 years, the ponds at Abbey Farm have held almost no pondweeds. Plants grow around the pond edges but within the water bodies themselves the only common, noticeable plant is blanket weed (the filamentous alga). This environment supports a narrow range of freshwater invertebrates with the most frequent species being zooplankton (such as *Daphnia*, commonly known as water fleas) water-boatmen and various fly and midge larvae. The ponds therefore seem of low overall wildlife value despite the presence of birds such as Kingfisher and Little Grebe.

On three occasions in the past we have seen the brief appearance of pondweeds just after digging out sediments from a silted up pond. The species that grew included Horned Pondweed (*Zannichellia palustris*), Opposite-leaved Pondweed (*Groenlandia densa*), Stonewort (*Chara vulgaris*), Reedmace (*Typha latifolia*), Starwort sp. (*Challitriche* sp.), Water Milfoil (*Myriophyllum spicatum*) and Broad-leaved Pondweed (*Potamogeton natans*). Other than Broad-leaved Pondweed in one pond, these appearances lasted just 1-2 years and rarely resulted in prolific growth. However, these events seemed to indicate that sediment removal increased the chances of weeds growing.

In 2014 we took ecological advice from two sources about how to improve the wildlife quality of the wetland system here. The opinion of both was that the over-riding agent reducing the ecological value was feral Greylag and Canada Geese. The presence of a large combined population of these birds (c.30 breeding pairs and 100-250 during the winter) was leading to eutrophication by droppings, and sedimentation and bank damage due to geese hauling themselves in and out of water bodies and digging into pond banks to eat plant rhizomes. I also wondered if the geese may be grazing off or uprooting any pondweeds that may start growing.

Design of the experimental area and pondweed/fauna monitoring

We wanted to investigate these two possible contributory factors to the lack of pondweeds growing at Abbey Farm. So, in late 2015 we removed the recent sediments from an arm of the largest pond and fenced parts off from wildfowl and/or cattle, helped by West Norfolk Conservation Volunteers. Photograph 1 below shows the experimental area.



Photograph 1: the experimental area showing cattle fencing and area netted off from wildfowl. Sediment was removed from beyond the low stone wall which stops sediment from the rest of the pond flowing back into the experimental area. In the foreground is an area from which sediment has not been removed and is not netted from cattle or wildfowl. This area was also monitored as part of the experiment.

This created four areas with the following characteristics with regards to sediments and exclusion of cattle and wildfowl:

Area	Sediment removed?	Fenced from cattle?	Netted to keep birds off?
A	no	no	no
B	yes	yes	no; directly connected to rest of the main pond
C	yes	yes	no; separated from the main pond by Area D
D	yes	yes	yes

In each of these areas we did the following monitoring:

Date	visual assessment of pondweeds & zooplankton	visual assessment of fauna	counts of fauna from 2 x 1m sweep of pond dipping net
June 6th	yes	some	no
July 18th	yes	yes	yes
Aug 23rd	yes	yes	yes

Monitoring results

Appendices 1 and 2 show the plant and fauna records. For each of the four sections, the main features found during monitoring were:

Area A (sediment still present; open to cattle and wildfowl; part of larger pond) - see Photograph 2

Plants: Other than Amphibious Bistort (*Persicaria amphibia*), no pondweeds grew. Early on some terrestrial plants grew that established in the previous autumn when the pond was mainly dry. There was some patchy blanket weed.

Fauna: Small water-boatmen were the commonest medium-sized invertebrate, followed by various fly larvae. Surface-dwelling flies were commonest here. One leech was found. One stickleback was seen. Zooplankton were least common here in June, but much more common in August than in the other three sections



Photograph 2: no pondweed growth in Area A (18th July 2016)

Area B (sediments removed; open to wildfowl; cattle fenced out; separated from main pond area by low, stone barrier) - see Photograph 3

Plants: Amphibious Bistort was present. Stonewort and a Water Crowfoot sp (probably *Ranunculus aquatilis*) had established by early June, the former being common, but both were heavily grazed by July and had disappeared by late August. A few terrestrial plants were present in June. There was a small amount of blanket weed in June and July.

Fauna: in July small water-boatmen were the commonest medium-sized invertebrate, but fly larvae were commonest in August (including Appendix 2 'Small, swimming worm', only found here). Mayfly larvae, mites, ramshorn snail and leech were found in small numbers. One tadpole was seen in July and stickleback were recorded in July and August. Zooplankton were common in June and July but not recorded in August.



Photograph 3: remnants of Stonewort (*Chara vulgaris*) plants and traces of blanket-weed in Area B (18th July 2016)

Area C (sediments removed; open to wildfowl; cattle fenced out; separated from main pond by areas B and D – that is, a low, stone barrier and the wildfowl-proof netting) - see Photographs 4 & 5

Plants: in June Stonewort, Starwort and Water Crowfoot were present, all showing less signs of grazing than in Area B. Amphibious Bistort was present as a flowering plant, mint-type plants survived throughout and forget-me-not type plants appeared in June but had gone in July. Blanket weed was either absent or very uncommon. What looked like small, round algae appeared in August.

Fauna: small water-boatmen were the commonest in July and August followed by ramshorn snails. Two mayfly were recorded in July when there was also a leech. Whirlygig beetles were present in July and August. Stickleback were recorded in both months but tadpoles were not found in either. Zooplankton were common in June and July but not recorded in August.

Photograph 4: Stonewort, Starwort, Water Crowfoot and what are probably Water Forget-me-Not and Water Mint growing in Area C, 6th June 2016





Photograph 5: Area C in mid-July. Most of the weeds shown in Photograph 4 have been grazed off

Area D (sediments removed; netted from wildfowl; cattle fenced out; separated from main pond by Area B – that is, a low, stone barrier) - see photographs 6 & 7

Plants: Stonewort was common throughout, covering 80-90% of the pond floor area in August. Water Crow-foot was numerous, flowered and produced seeds during June and July, but had disappeared or been lost among the Stonewort by August. Horned Pondweed was present throughout, also produced seeds and had become numerous by August. Amphibious Bistort, mint-type, forget-me-not type and Reedmace were present for all or the majority of the time and Fool's Water-cress (*Apium nodiflorum*) was recorded in July. Blanket weed was present in small/moderate quantities throughout.

Fauna: small water-boatmen and mayfly larvae were common in July and August and ramshorn snails became very common in August. Fly larvae, surface flies and leeches were not recorded here, but all other fauna were at their most common in this area. Large water-boatmen, small water beetles, red water mites, spire-shell snails and water stick-insect were only recorded here. Stickleback were numerous in July and August while tadpoles were common in July. Whirlygig beetles were present in August. Zooplankton followed the same pattern as Areas B and C – common in June and July, not recorded in August.



Photograph 6: growth of Stonewort (*Chara vulgaris*) in Area D, 18th July 2016



Photograph 7: plants of Water Crowfoot (top left) and Horned Pondweed (bottom right) growing the c.90cm from the pond floor to the surface. Both species went on to produce seed

Discussion

The experiment shows that pondweeds grow in this particular pond at Abbey Farm if sediments are removed and cattle and wildfowl are excluded. Several species established, some being numerous. Alongside the pondweeds there was a range and number of fauna that is very rich by the standards of Abbey Farm. The wildlife community in this small, protected area is unlike anything seen in this pond for about 20 years. At no time has a community like this been sustained beyond a year or two in any part of the main pond system here during the last 40 years.

The appearance and then loss of pondweeds in Areas B and C seems to indicate that removal of the pond sediments permits a range of pondweeds to grow. The presence of wildfowl then seems to have resulted in the loss of these pondweeds, presumably through grazing. This contrasts to Area D where the absence of wildfowl let the pondweeds flourish so that some species produced seed.

Personally, I would prefer to see the ponds here supporting a wide diversity of freshwater flora and fauna. I feel this experiment indicates this could be possible if sediment removal and excluding cattle, both of which we've tried before, are combined with reduction of grazing pressure from wildfowl.

Feral geese have been identified as a major cause of environmental damage to the wetlands at Abbey Farm. The population of Greylag and Canada Geese is lower than it was five years ago due to frightening, egg destruction, and, on a less frequent basis, shooting (the latter two being carried out under licence). Despite this, I believe these geese may still account for about 70% of pondweed grazing in the summer of 2016. This is all approximate and involves a lot of guesswork (see Appendix 3). However, to me it indicates feral geese could still be significant grazers of pondweeds.

It seems to me that any future removal of sediment is more likely to result in sustained pondweed growth if we already have an established background of little or no grazing by feral geese. Achieving this may well need us to make quicker interventions when geese appear on the wetlands and to maintain the integrated use of the above techniques.

Frightening can be effective. 120 were present in early August 2016. These dropped to single figures following three days of repeated, immediate frightening when any geese arrived. We usually do this by walking towards the geese waving a white cloth. We continued during September and had no records of geese landing for more than a few minutes, followed by no records of geese on the ground so far in October. However, past experience has shown the geese become much more persistent in the spring when they are returning to breeding grounds.

While reducing the goose population may deny us the spectacle of seeing them, if their drop in numbers results in a more vibrant freshwater community, we may see increases in other species. Beneficiaries could include amphibians, mammals (Water Vole?) and birds like waders and grebes, plus the invertebrates and pondweeds themselves.

Mallard, Gadwall, Moorhen and Coot are highly likely to remain numerous, joined by smaller numbers of Shelduck, Little Grebe and Egyptian Geese in the breeding season. Teal are very common in the winter. On a larger scale than our experiment, where netting is not possible, some of these wildfowl will graze pondweeds. However, if the area of pondweeds exposed to these grazers is larger there may be a balance that allows pondweeds and the associated invertebrates to survive alongside wildfowl.

Appendix 1. Plant records 2016

Area	Date	Stonewort (<i>Chara</i> sp., possibly all <i>C. vulgaris</i>)	Blanket weed (filamentous alga)	Small algae	Water Crowfoot (<i>Ranunculus</i> sp.)	Horned Pondweed (<i>Zannichellia palustris</i>)	Starwort sp. (<i>Callitriche</i> sp)	Terrestrial plants	Reed-mace (<i>Typha latifolia</i>)	Bistort (<i>Persicaria</i> sp)	Mint type (probably <i>Mentha aquatica</i>)	Water Forget-me-not type (<i>Myosotis scorpioides</i> ?)	Rush type (<i>Juncus</i> sp)	Fool's Watercress? (<i>Apium nodiflorum</i> ?)
A	6th June		some					common						
A	18th July		some thin-layer patches							yes, grazed, no flowers				
A	Aug 23rd		some small, old, dark brown remnants											
B	6th June	Common, all small, grazed	very little		Few, small, grazed			some						
B	18th July	a few, severely grazed	very little				one			some non-flowering				
B	Aug 23rd									yes				
C	6th June	Common, medium-sized, some grazed			Several, medium-sized (not to surface), some grazing		A few medium-sized				yes	yes		
C	18th July	numerous small-medium plants; no patches	very little							several flowering	yes			
C	Aug 23rd			numerous, small, round						yes	yes			
D	6th June	Common, larger, not grazed	some at depth		Several plants, large (from pond floor to surface), flowers	A few plants, some large (from pond floor to surface), not grazed					yes	probably yes		
D	18th July	50% cover, some 30-40cm high, numerous dense patches	some old patches on surface		a few old stems, some new leaf growth	A few old stems; one bit of new leaf			yes	several flowering	yes	yes		yes
D	Aug 23rd	c.85% cover, dense patches, high	small floating, bubbly, pale green patches			a few large plants			yes	yes	yes	yes	yes	

Appendix 2. Fauna records 2016

The table below shows the fauna records from the four experimental areas from the three recording visits in 2016. Two of these visits included counts of fauna caught in two 1m long sweeps of a pond net. These figures are highlighted in orange. Records highlighted in yellow are from visual assessments. Zooplankton were not included in the counts but their presence is recorded. There are summary figures on the right-hand side of the table. These show that the counts of fauna (excluding zooplankton) in Area D, where there was the greatest pondweed growth, were higher.

'com.' = common, 'sev.' = several

Area	Date	Zoo-plankt on	Small water boat-man	Blood worms	Mayfly larvae	Small, swim-ming worm	Ram-shorn type snail	Stickle-back	Large water boat-man	Leech	Spire-shell type snail	Mites	Small water beetle	Midge larvae	Sur-face flies	Dam-selfly	Whirly-gig beetle	Tad-pole	Pond skater	Water stick-insect	No. types re-corded	No. individuals netted (excl. zooplankton)	
A	6th June	rare	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.		
A	18th July	com.	c.50	3			1	1							com.					n.r.	5	54	
A	Aug 23rd	very com.	40	6	1					1				6	a few small	yes			yes	n.r.	9	54	
B	6th June	com.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.		
B	18th July	com.	c.50		1	1		a few		yes					a few	yes				1	9	52	
B	Aug 23rd		3	4		20	3	1		1		1 dark		5		yes		yes	n.r.	10	40		
C	6th June	com.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.		
C	18th July	com.	c.35		2		8	1		yes						yes	a few		a few	n.r.	8	45	
C	Aug 23rd		12				5	1 small									com.		very com.	n.r.	5	17	
D	6th June	com.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	sev.	n.r.	n.r.	n.r.		
D	18th July	com.	c.50		30		6	5	1				a few			yes	com.	sev.			8	92	
D	Aug 23rd		80		15		200	4	20		14	2 red	2			yes	yes	com.	2	12	337		

Appendix 3: Estimating the extent to which different wildfowl at Abbey Farm in 2016 might contribute to the grazing of pondweeds

The table below attempts to estimate the contribution each wildfowl species found at Abbey Farm makes to the grazing of pondweeds during the summer. It combines a score for how important pondweeds seem in the diet (judged by information given in 'Birds of the Western Palearctic', 1980), the June population (June as it seems to be a critical month for grazing impact), the typical weight of an adult bird and a score for the extent to which the species seems to feed in ponds which at Abbey Farm.

	Moorhen	Coot	Mallard	Gadwall	Greylag	Canada	Shelduck	L. Grebe	Egyptian	Teal	Tufted D	Shoveller
Extent of vegetarian diet and tendency to eat pondweeds (low score = apparently low tendency to eat pondweeds)	3	4	3	4	4	4	1	0	4	3	2	1
June population at Abbey Farm	25	8	40	10	45	6	6	2	4	2	8	2
weight in kg	0.3	0.7	1.1	0.81	3.4	4.6	1.1	0.15	2.2	0.34	0.8	0.62
Extent to which species feeds in ponds while at Abbey Farm (high score = high degree of feeding in ponds)	3	3	2	3	2	2	3	4	2	3	4	4
Factored 'pond weed eating at Abbey Farm' score (the above four figures multiplied by each other)	67.5	67.2	264	97.2	1224	220.8	19.8	0	70.4	6.12	51.2	4.96
Total of factored scores	2093.18											
% of total of factored scores	3	3	13	5	58	11	1	0	3	0	2	0