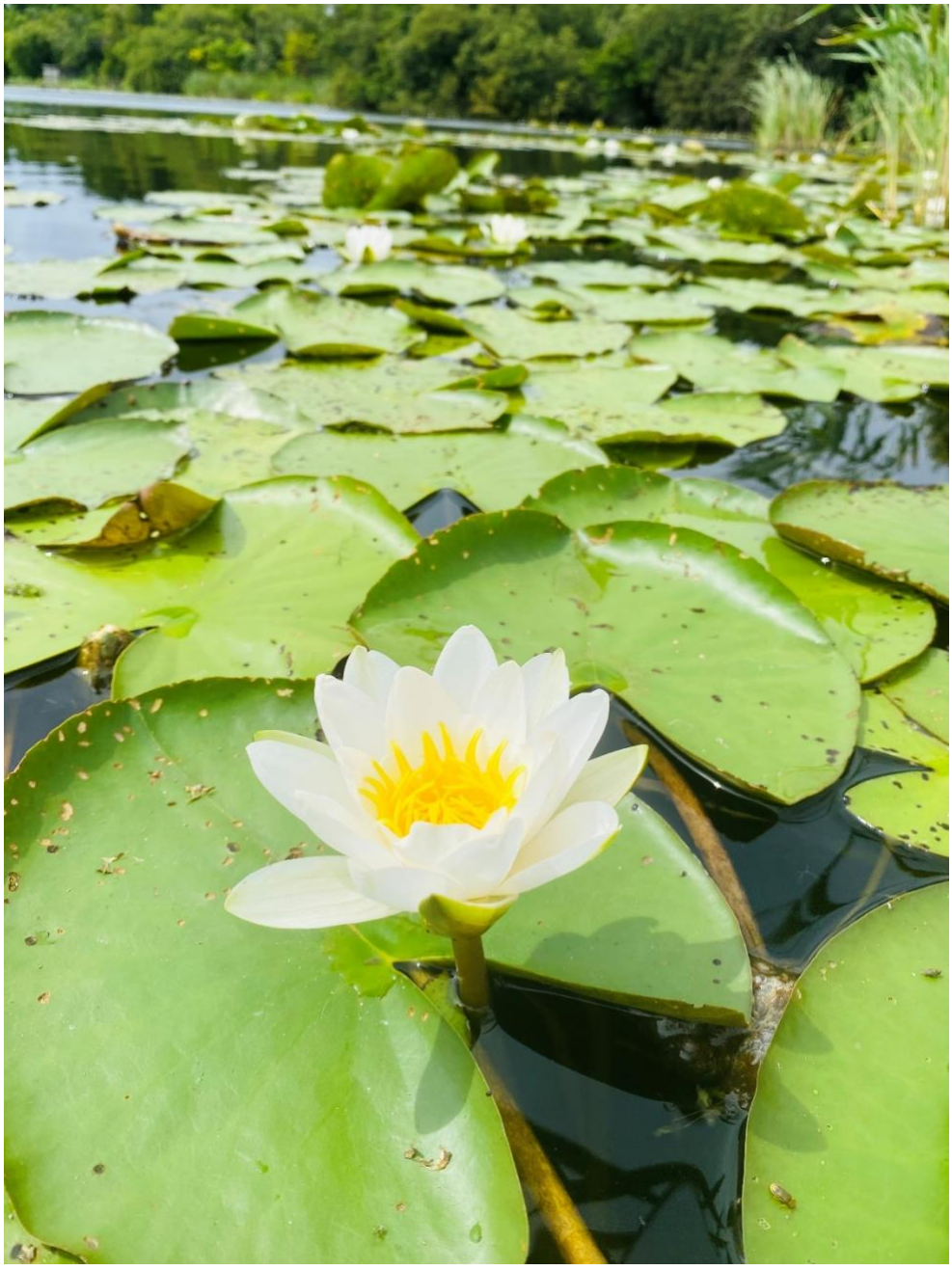
Broads Annual Water Plant Monitoring Report 2025



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Broad plant survey: 2025 Annual Report

Executive Summary

The Broads Authority have surveyed the water plant communities within the Broads since 1983. The Broads Annual Water Plant monitoring programme provides information on the diversity of species and a measure of abundance. The programme has consistently surveyed key broads, such as Hickling Broad (a prime navigation site with high recreational value) and Cockshoot Broad (previously undergone restoration measures), providing long term datasets. Between 1983 and 2013, a transect-based technique was used for the monitoring programme. Due to limitations in the efficiency of the methodology along with the improvements in water plants generally across the Broads, a new point -based technique was developed and implemented. Point sample surveys have been conducted since 2014.

Water plants (also known as macrophytes) in the Broads are inherently highly variable in both abundance and species richness between years, so limited significance should be attached to variation in these parameters between one individual year and the next.

This report presents and discusses the findings from the annual water plant surveys carried out during 2025, which covered 19 broads, with a total of 494 survey points.

- Overall, 57% (11/19) of the broads surveyed showed an increase in total species abundance of water plants. 32% (6/19) of broads showed a decrease in total abundance. The remaining 11% (2/19) of the surveyed sites showed very little change.
- Most of the broads connected to the Bure River recorded an increase in abundance, with Hoveton Great Broad being the exception.
- The Ant catchment had a mix of increases and decreases in summary abundance.
- The Yare catchment had one broad surveyed which showed an increase in summary abundance.
- The Thurne catchment mainly saw decreases in summary abundance with Horsey Broad being the exception. Heigham Sound, Hickling Broad, Martham North and Martham South saw decreases.
- Stonewort's were dominant in Hickling Broad, Martham North, Martham South and Upton Little Broad and were also recorded in Cockshoot Broad, Calthorpe, Heigham Sound, Little Broad, Reedham Water, Rockland Broad, Salhouse Broad, Upton Broad, and Wroxham Broad. Stonewort abundance levels vary across the broads with 21% (4/19) of the broads surveyed showing an increase and 47% (9/19) a decrease.

- Vascular macrophytes were dominant in 10/19 sites this year including Alderfen, Calthorpe, Cockshoot Broad, Heigham Sound, Horsey Mere, Hoveton Great Broad, Reedham Water, Salhouse Broad, Upton Broad and Wroxham Broad. Abundance levels vary across the broads but 57% (11/19) showed an increase, 16% (3/19) a decrease and 21% (4/19) were similar to the year before.
- Macro Algae and Mosses increased in 26% (5/19) of broads and Little Broad had the greatest abundance of macroalgae in 2025 of all the broads. Decreases were seen in 26% (5/19) of the broads surveyed and 32% (6/19) recorded little change.
- Free-floating or round floating leaved macrophytes had increases in 32% (6/19) of broads with Rockland Broad having the greatest abundance in 2025 of all the broads. Decreases were recorded in 5% (1/19) and 32% (5/19) recorded little change.

Introduction

Background information

The Broads Authority (the Authority hereafter) has monitored aquatic macrophytes (water plants hereafter) annually at numerous broads within its Executive Area since 1983. The water plant monitoring programme has provided data on species richness (number of species) and a measure of abundance of the water plants present in each of the broads surveyed. The surveys have created long-term datasets, provided vital information in monitoring the response of a number of broads to restoration measures such as suction dredging and / or biomanipulation and are contributing to scientific reviews of key broads (http://www.broads-authority.gov.uk/__data/assets/pdf_file/0006/549114/Broads-Lake-Review.pdf).

Following increased water plant growth across many of the broads, it was acknowledged that the transect methodology (employed until 2013), was difficult to implement in a robust and consistent manner required for analysis of long-term trends. Following consultation with Natural England, Environment Agency, Dr Nigel Wilby (University of Stirling) and other researchers, a point-based survey methodology was developed. Between 2011 and 2013, the point sample survey was conducted alongside the transect surveys. The purposes of the concurrent surveys was to understand if the data gathered was directly comparable and would allow long-term trend analysis. Whilst research undertaken by Dr Nigel Wilby, revealed the data gathered by the two techniques was not directly comparable, the point-based technique was adopted as the method for the Broads Annual Water Plant Monitoring programme from 2014 onwards.

Aims & objectives

The main objectives of the annual programme are to monitor key broads with long-term datasets, those that have undergone restoration measures or those that are known to be experiencing a change in their water plant community. Broads that have not received restoration efforts or are stable (with or without water plants) are monitored on a less frequent basis. When resources allow, the monitoring of sites not previously surveyed is an ongoing objective. River stretches are also surveyed annually, focusing on the upper reaches where plant growth is concentrated.

The general aim of the monitoring programme is to monitor water plant growth and provide an assessment of the condition, or health, of the broads and waterways within the Broads. The monitoring programme also provides an assessment of Section 41 species, Species “of principal importance for the purpose of conserving biodiversity” covered under section 41 (England) of the NERC Act (2006) and therefore need to be taken into consideration by a public body when performing any of its functions.

Two types of surveys are undertaken as part of the monitoring programme, point sample surveys to assess species diversity and provide a measure of abundance within a broad or

stretch of river and hydroacoustic surveys, which use sonar technology to estimate cover and volume of water plants along transects.

The purpose of this report is to present the results of the 2022 survey season.

The data gathered through the water plant and hydroacoustic surveys and presented within these reports are used to:

- Report the status of conservation priority species, e.g. certain stoneworts and Holly-leaved naiad (Section 41 priority species)
- Assess the condition of designated sites (SSSIs) and WFD waterbodies in partnership with NE and EA respectively.
- Assess the success of restoration measures such as catchment or in-lake projects by managers and research scientists as well as assessing long-term trends
- Assess the impact of and ability to cut water plants to allow the safe passage of boats.

Methodology

Survey design

The point sample survey was designed in consultation with Dr Nigel Wilby using Broad's species accumulation data. The data generated a relationship (y = 4.6242ln(x) + 17.149) between the area of the open water of a broad and the required number of points to be sampled (see Figure 1). Using ArcGIS, the area of open water of each broad to be surveyed was measured in hectares (ha) and the number of sample points calculated. Once the required number of points was calculated, a grid system was applied over an aerial image of the open water areas of each broad. Sample points were set equidistant from each other and the co-ordinates generated (see Figure 2). The maps and sample point co-ordinates were loaded onto a Samsung tablet for the survey teams to use.

Figure 1

The relationship between the area of open water and the required number of points sampled.

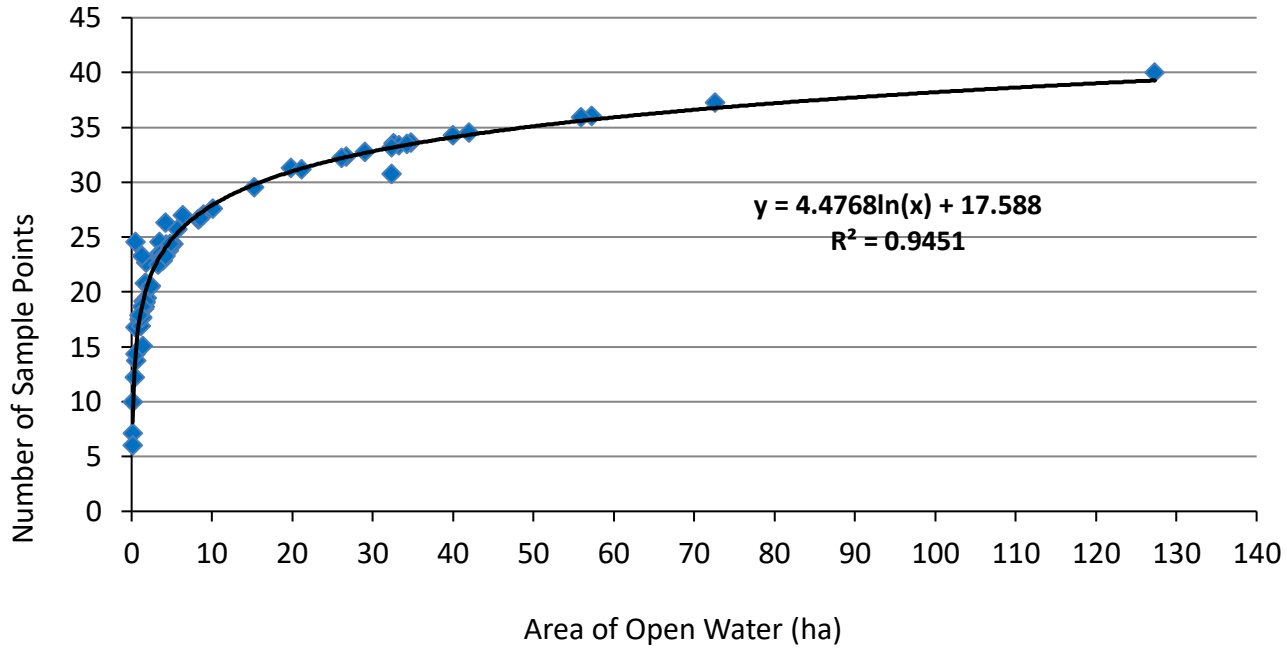
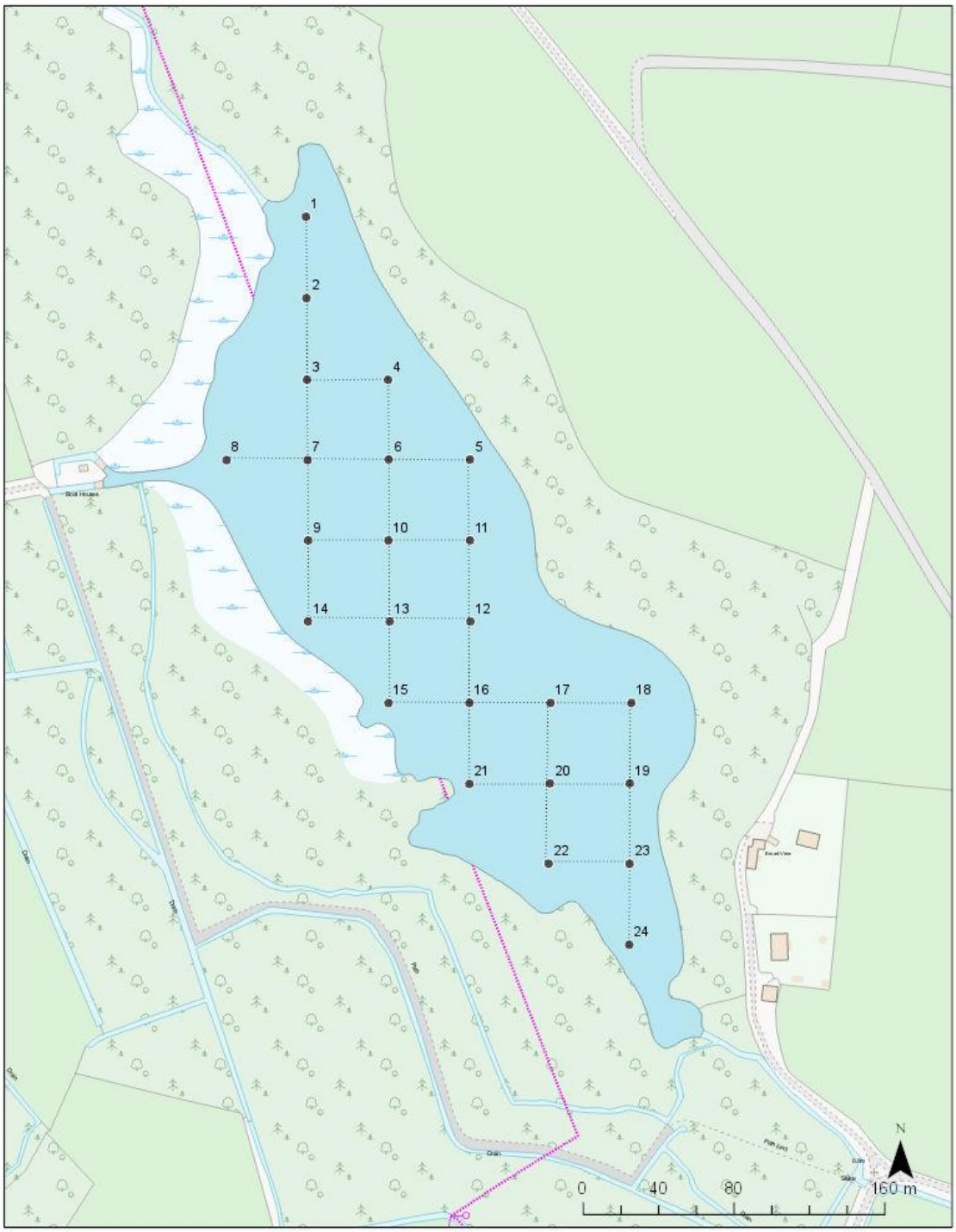


Figure 2

Map showing the sample points of Alderfen Broad



Sample points at Alderfen Broad

Point sample survey technique

At each broad, the surveyors used the maps and grid references on the Samsung tablet and GPS to navigate by boat to each of the sample points. Once within 5 m of the plotted grid reference, mud weights were deployed to keep the boat in the correct location.

At each sample point, a double headed survey rake was thrown north and south, at each sample point, at a distance of 5 m from the boat edge. The rake was left for 10 seconds to sink to the bottom after which the rake was pulled slowly and steadily back towards the boat. For points that were in known deeper water, additional rope was thrown to allow the rake to sink and rest on the bed of the lake at a distance of 5m from the edge of the boat.

On retrieval of the rake, the plants attached to the rake head were collected in a white survey tray. If necessary, plants were washed to remove excess sediment to aid identification. All the live plant material was identified to species level wherever possible. For example, some particularly difficult groups e.g. any non-fruiting starworts *Callitriche* sp. were only identified to genus level. Any unidentified plant specimens (or where identification was uncertain) were collected in plastic bags and labelled using the station number reference. These samples were then taken for subsequent observation using a high-powered microscope, or sent for expert identification. Wherever possible, voucher specimens were pressed and dried using standard herbarium techniques.

To assign a level of abundance for each species, the total volume of live water plant material was scored based on the maximum trap-ability on the rake. Scores attributed to each species present range from 10% (low abundance) and 100% (the maximum trappable) in increments of 10%. For example, if the maximum plant volume was present on the rake, but split equally between two species then each species would be scored 50%. In addition, scores of 1% were given to trace and very small amounts of identifiable plant material.

The ‘trap-ability’ of a particular species on the rake, was taken into account so that a score of 100% represents the maximum amount trappable on the rake. For example, a fine leaved species such as Unbranched bur-reed *Sparganium emersum* is not as ‘trappable’ on the rake as a more structured species such as Spiked water milfoil *Myriophyllum spicatum*. Surveyor experience and judgement is therefore important in scoring the less trappable species based on the likelihood of being retrieved in the rake and possibly other visual indications. The risk being that high abundances of less trappable species are routinely under-scored compared to more easily retrieved species. Other less trappable water plant families include duckweeds Lemna sp. and water lilies.

The maximum total of all species abundance scores on an individual rake sample cannot really be more than 100%, although ± 10% is considered acceptable to account for the varying trap-ability of different species.The broads that have been sampled between 2014 and 2025 are presented in Table 1. Surveys are conducted during the summer period, July to September.

Table 1

Sites surveyed as part of the monitoring programme between 2014 and 2025.

Broad	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Alderfen Broad	X	X	X	X	X	X	X	X	X	X	X	X
Bargate Broad	X			X			X			X		
Barnby Broad		X										
Barton Broad	X	X	X	X	X	X	X	X	X	X	X	X
Belaugh Broad				X					X			
Blackfleet broad			X									
Bridge Broad		X					X			X		
Buckenham Broad		X		X						X		
Burntfen Broad			X						X			
Buttle Pools										X		
Calthorpe Broad	X							X				
Catfield Broad		X										X
Cockshoot Broad	X	X	X	X	X	X	X	X	X	X	X	X
Cromes Broad	X	X	X	X	X	X	X	X	X	X	X	X
Decoy Broad	X		X		X		X		X		X	
Hassingham Broad		X		X						X		
Heigham Sound	X	X	X	X	X	X	X	X	X	X	X	X
Hickling Broad	X	X	X	X	X	X	X	X	X	X	X	X
Horsey Mere	X	X	X	X	X	X	X	X	X	X	X	X
Hoveton Great Broad	X	X	X	X	X	X	X	X	X	X	X	X
Hoveton Little Broad	X			X			X		X		X	
Hudson's Bay		X			X		X	X	X	X	X	
Little Broad			X						X			X
Malthouse Broad							X					
Martham Broad North	X	X	X	X	X	X	X	X	X	X	X	X
Martham Broad South	X	X	X	X	X	X	X	X	X	X	X	X
Mautby Decoy			X									
Norton's Broad			X						X			
Oulton Broad			X									
Pound End		X					X		X		X	
Ranworth Broad	X	X		X		X	X	X				
Reedham Water										X		X
Rockland Broad	X	X	X	X	X	X	X	X	X	X	X	X
Round Water Broad			X						X			

Broad	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Salhouse Great Broad									X			X
Sotshole Broad			X									
South Walsham Broad										X		
Sprat's Water			X						X			
Strumpshaw Broad		X			X			X			X	
Upton Broad	X	X	X	X	X	X	X	X	X	X	X	X
Upton Little Broad	X		X		X				X			X
Wheatfen Broad & Channels		X			X			X			X	
Whitlingham Great Broad	X	X	X	X	X							
Whitlingham Little Broad		X	X	X	X	X						
Woolner's Carr			X						X			
Wroxham Broad	X	X	X	X	X	X	X	X	X	X	X	X

Data processing

For each sample point, an abundance score for each species was calculated, derived from the data from the north and south throws;

$$\frac{\text{(Score from north + Score from south)}}{2}$$

The abundance score for each species was then totalled to produce an abundance score for each sample point. An overall mean abundance for each species for the whole broad was then calculated by summing the scores from each sample point and dividing by the number of sample points. The overall mean abundance score for each species was then added together to give the overall total abundance score for the broad. Assuming maximum plant abundance on the site, the site abundance score should have a maximum of 100 (± 10%).

The water plants present in the surveys were also categorised into groups, such as stoneworts or macro-algae, and abundance scores were calculated for each group in each broad, as described above. The water plant groups and the species within them are presented in Appendix I.

Results

Section 41 Species

Species "of principal importance for the purpose of conserving biodiversity" covered under Section 41 (England) of the NERC Act (2006). These species need to be taken into consideration by a public body when performing any of its functions.

Table 2

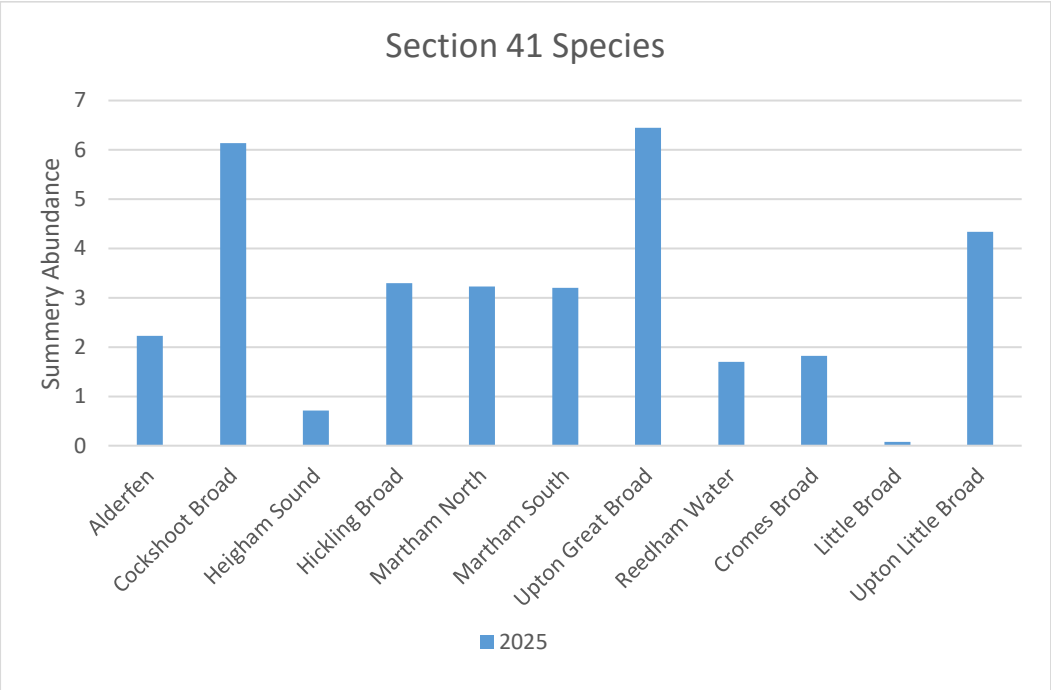
Ten broads were found to have Section 41 species in 2025.

Species	Broads
Holly-leaved naiad- *Najas marina*	Alderfen Broad, Cockshoot Broad, Heigham Sound, Hickling Broad, Martham South, Reedham water, Upton Great Broad, Upton Little Broad, Little Broad
Baltic stonewort - *Chara baltica*	Heigham Sound, Hickling Broad, Martham North, Martham South, Upton Little Broad
Intermediate stonewort - *Chara intermedia*	Heigham Sound, Hickling Broad, Martham North, Martham South, Upton Little Broad
Convergent stonewort - Chara connivens	Not seen specifically – glob/cons was seen
Starry stonewort *Nitellopsis obtusa*	Heigham Sound, Hickling Broad, Martham South

As can be seen from this table, the broads in the Thurne are an important site for Section 41 species.

Graph 1

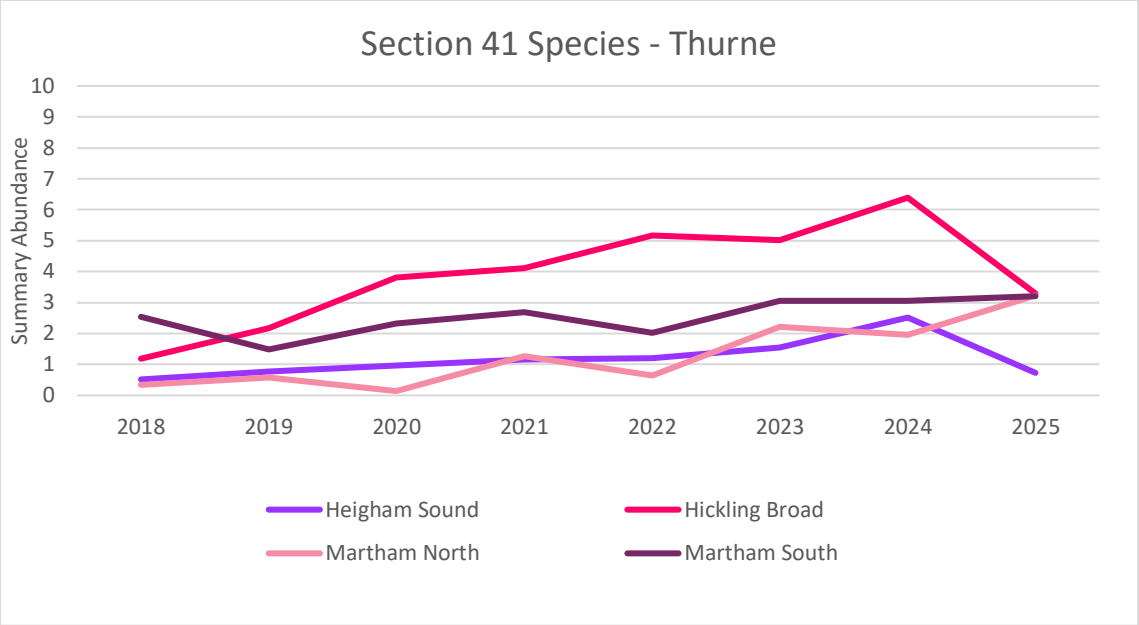
2025 abundance scores for Broads with Section 41 species



NB: Summary abundance axis usually sees ranges up to 10 in score, but to show the smaller values for section 41 species the axis has been reduced for this graph.

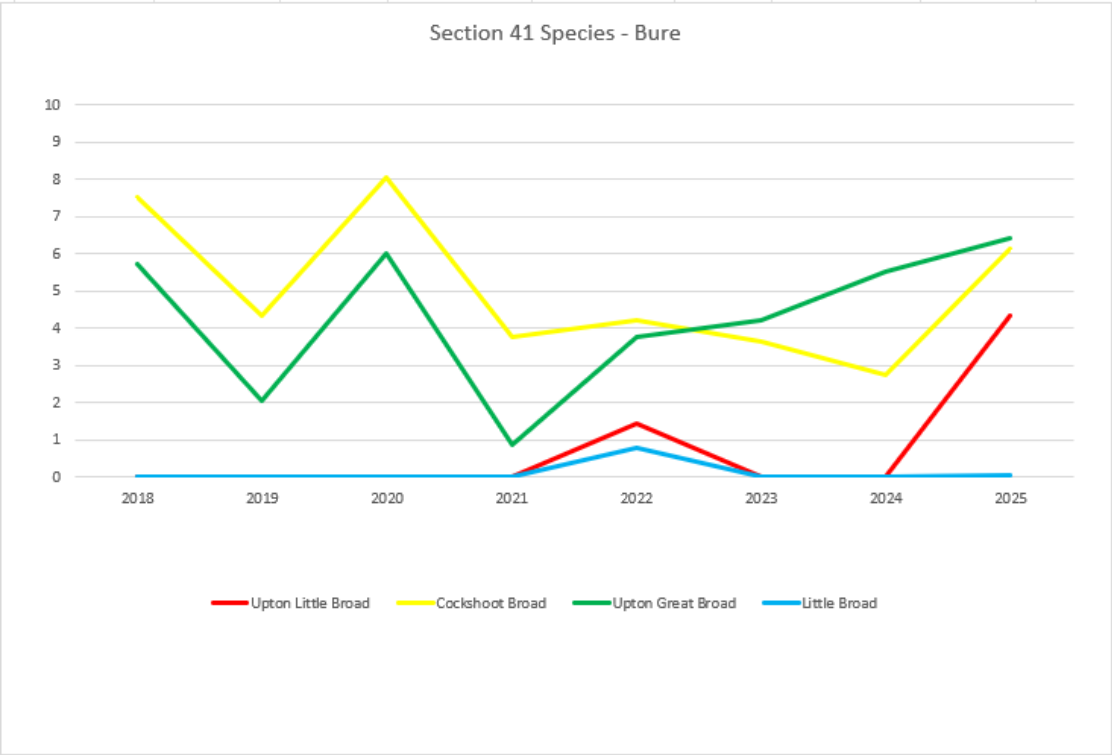
Graph 2

Section 41 species abundance between 2018 – 2025 grouped by catchment areas.



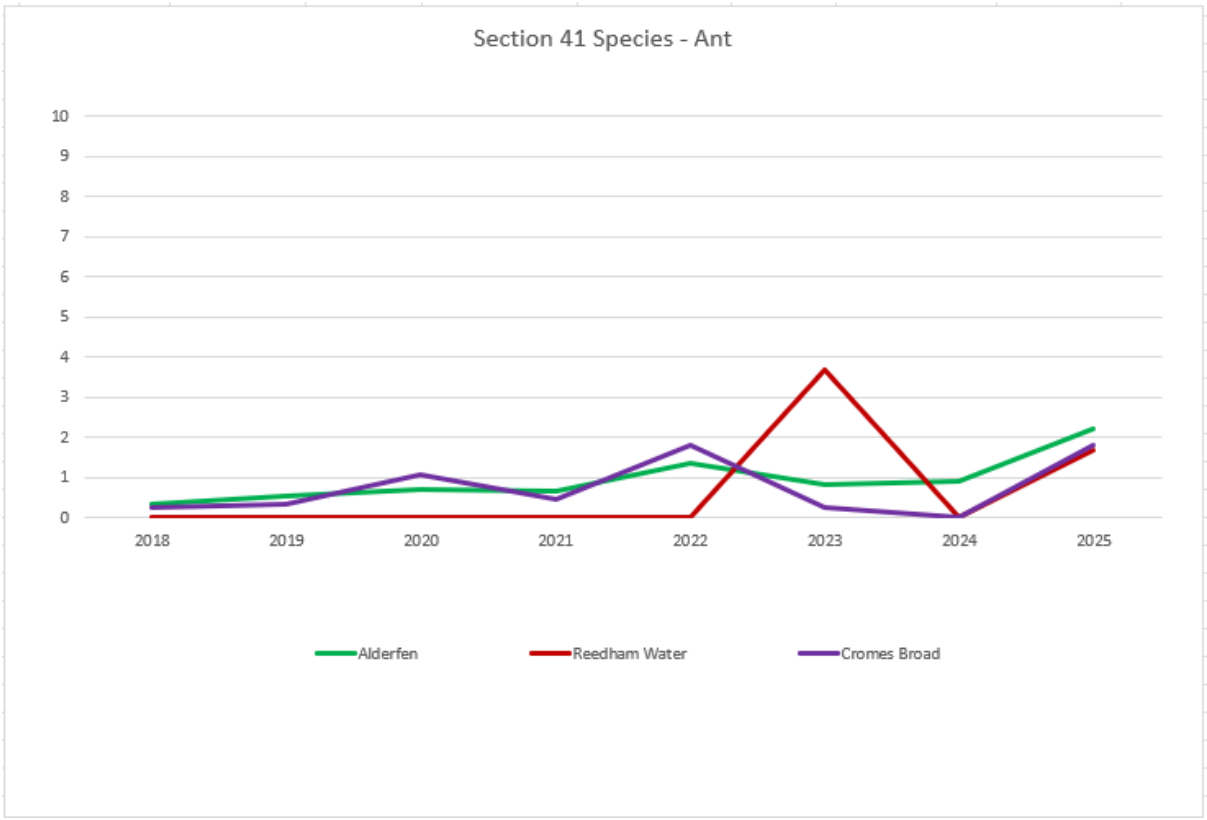
Graph 3

Section 41 species abundance between 2018 – 2025 grouped by catchment areas.



Graph 4

Section 41 species abundance between 2018 – 2025 grouped by catchment areas.



Main Survey Results

The data collected from each broad is presented as species richness (the number of species recorded) and abundance (the amounts of each species recorded) according to the point survey and scoring method (outlined in Methodology).

The results tables also illustrate the number of points at which each species was recorded, giving an indication of the frequency of occurrence.

Appendix 1 lists the common and Latin names for all plants found to date during water plant surveys in the Broads.

Thurne Valley

The Thurne valley broads contain two Annex I open water habitats and form a key part of the Broads Special Area of Conservation (SAC) designation. (Hard oligo-mesotrophic waters with benthic vegetation of stonewort species (3140), and Natural eutrophic lakes with Magnopotamion or Hydrocharition - type vegetation (3150)).

These bodies of water are a sanctuary for vulnerable and rare species which are stated in the Joint Nature Conservation Committee (JNCC) Red Data Book, including three vulnerable species: Baltic stonewort, Convergent stonewort and Starry stonewort, and one Rare species: Intermediate stonewort (Stewart and Church, 1992). They also provide a safe haven for the rare Holly-leaved naiad, which is a Section 41 priority species along with Baltic stonewort, Intermediate stonewort, Convergent stonewort and Starry stonewort , as well as more common vascular plants such as Spiked water milfoil and Mare's tail.

2025 Summary

This year there has been an assortment of results with increases and decreases. Hickling, Martham North, Martham South and Heigham Sound decreased in their overall abundances compared with 2024. Horsey Mere has similar abundance levels to last year whereas Calthorpe Broad had increased abundance levels to 4 years ago. The high variability of plant abundance between years highlights the importance of surveys carried out frequently and looking across multiple years. Horsey Mere continues to show low macrophyte levels compared to the other broads in the Thurne Valley.

Calthorpe

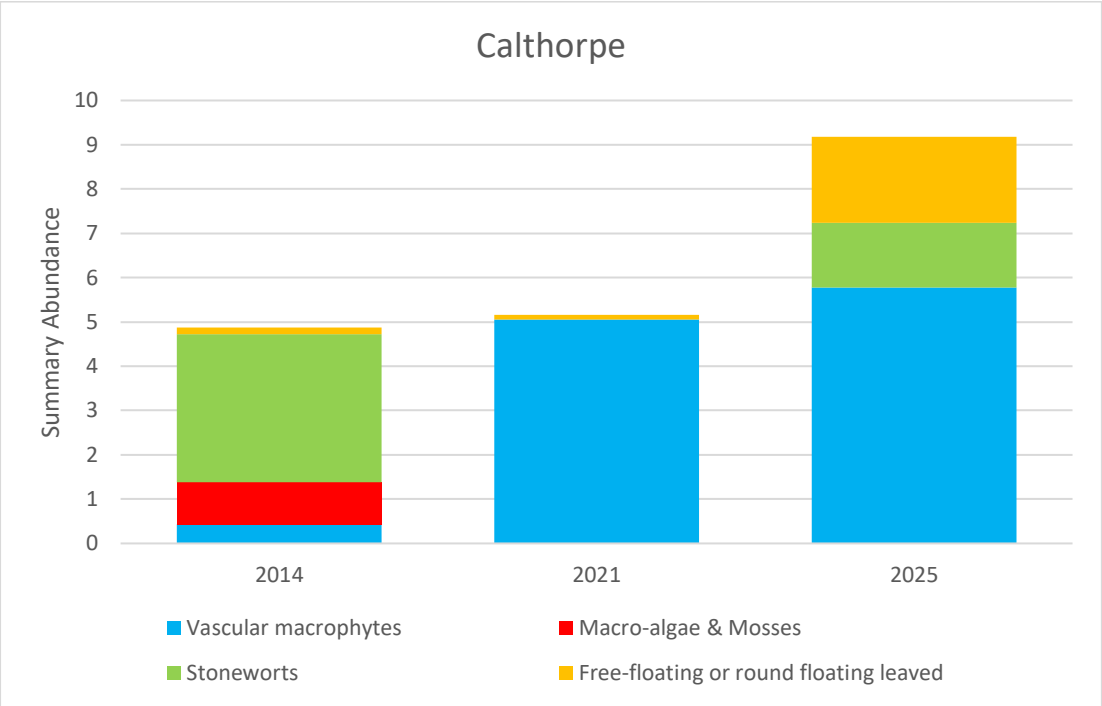
Table 3

Common Name	Scientific Name	Summary Abundance	Occurrences
Canadian waterweed	*Elodea canadensis*	3.167	10
Delicate stonewort	*C. virgata*	1.394	14
White water lily	*Nymphaea alba*	1.222	9
Unbranched bur-reed	*Sparganium emersum*	1.167	8
Yellow water lily	*Nuphar lutea*	0.722	8
Amphibious bistort	*Persicaria amphibia*	0.722	4
Broad –leaved pondweed	*P. natans*	0.561	7
Common water-plantain	*Alisma plantago-aquatica*	0.111	1
Bristly stonewort	*C. hispida*	0.056	1
Greater Pond sedge	*Carex riparia*	0.056	1
Total number of species recorded		**10**	**Total samples taken: 18**

Vascular macrophytes, fee floating or round leaved and stoneworts had all increased from 2021.

Graph 5

Calthorpe summary abundance shown in plant groups (see Appendix 1 for group details)



Heigham Sound

Table 4

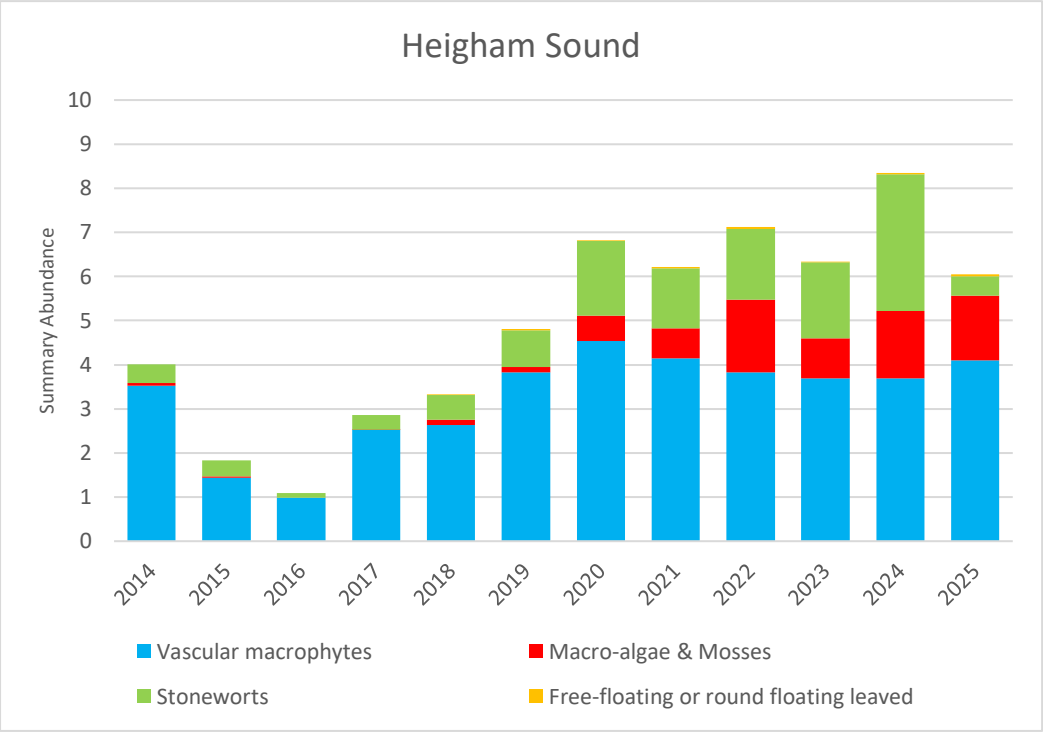
Common Name	Scientific Name	Summary Abundance	Occurrences
Spiked water milfoil	*Myriophyllum spicatum*	1.512	52
Filamentous algae	*Zygnematales*	1.473	30
Mare's tail	*Hippuris vulgaris*	0.879	18
Rigid hornwort	*Ceratophyllum demersum*	0.689	41
Starwort species	*Callitriche sp*	0.380	20
Starry stonewort	*Nitellopsis obtusa*	0.352	9
Holly-leaved naiad	*Najas marina*	0.318	3
Shining pondweed	*P. lucens*	0.076	4
Curled pondweed	*P. crispus*	0.061	4
Canadian waterweed	*Elodea canadensis*	0.045	3
Perfoliate pondweed	*P. perfoliatus*	0.045	2
Intermediate stonewort	*C. intermedia*	0.032	3
Whorled water milfoil	*Myriophyllum verticillatum*	0.032	3
Nuttall's waterweed	*Elodea nuttallii*	0.030	2
Delicate stonewort	*C. virgata*	0.030	2
No plants	*No plants*	0.030	6
Long-stalked Pondweed	*Potamogeton praelongus*	0.030	2
Ivy-leaved duckweed	*Lemna trisulca*	0.018	3
Yellow water lily	*Nuphar lutea*	0.017	2
Baltic stonewort	*C. baltica*	0.017	2
Willow-leaved pondweed	*P. x salicifolius*	0.017	2
Intermediate water-starwort	*Callitriche stagnalis*	0.015	1
Fan-leaved water crowfoot	*Ranunculus circinatus*	0.015	1
Stonewort (Chara) species	*Chara sp.*	0.005	3
Fragile/convergent stonewort	*C. globularis/connivens*	0.002	1
Spiked water milfoil	*Myriophyllum spicatum*	1.512	52

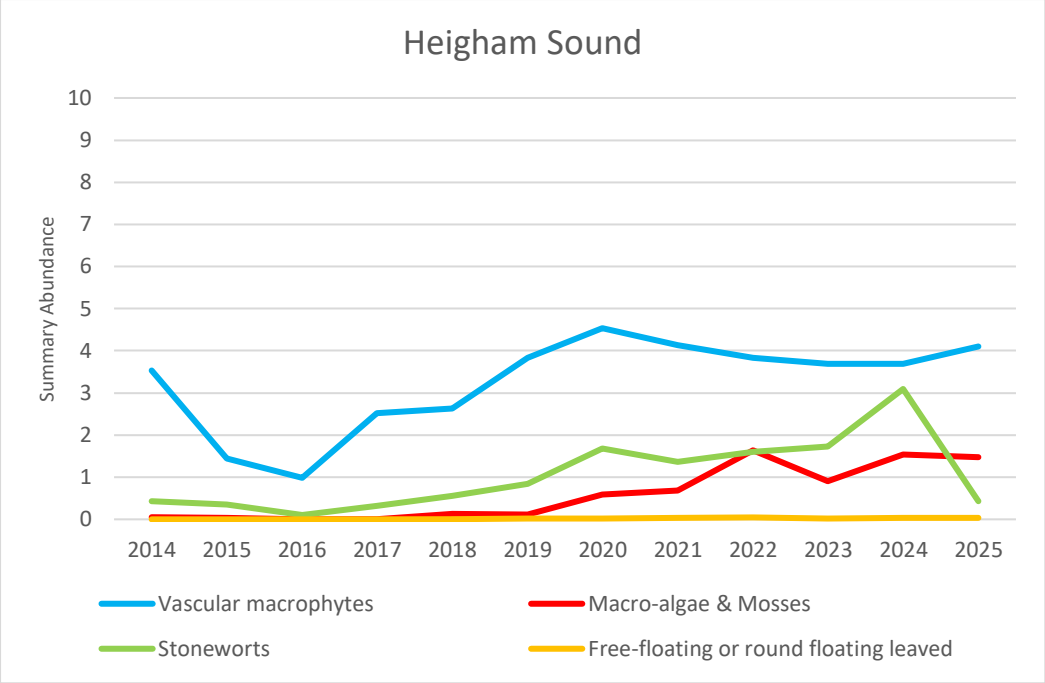
Common Name	Scientific Name	Summary Abundance	Occurrences
Total number of species recorded		**25**	**Total samples taken: 66**

There has been a decrease in overall summary abundance compared to 2024. Overall stonewort abundance decreased and a reduction in Intermediate stonewort (1.45 to 0.03) has contributed to this. Vascular macrophytes have seen an increase at some sample points with Spiked water milfoil increasing from 0.4 to 1.51.

Graph 6 & 7

Heigham Sound summary abundance shown in plant groups (see Appendix 1 for more detail)





Hickling Broad

Table 5

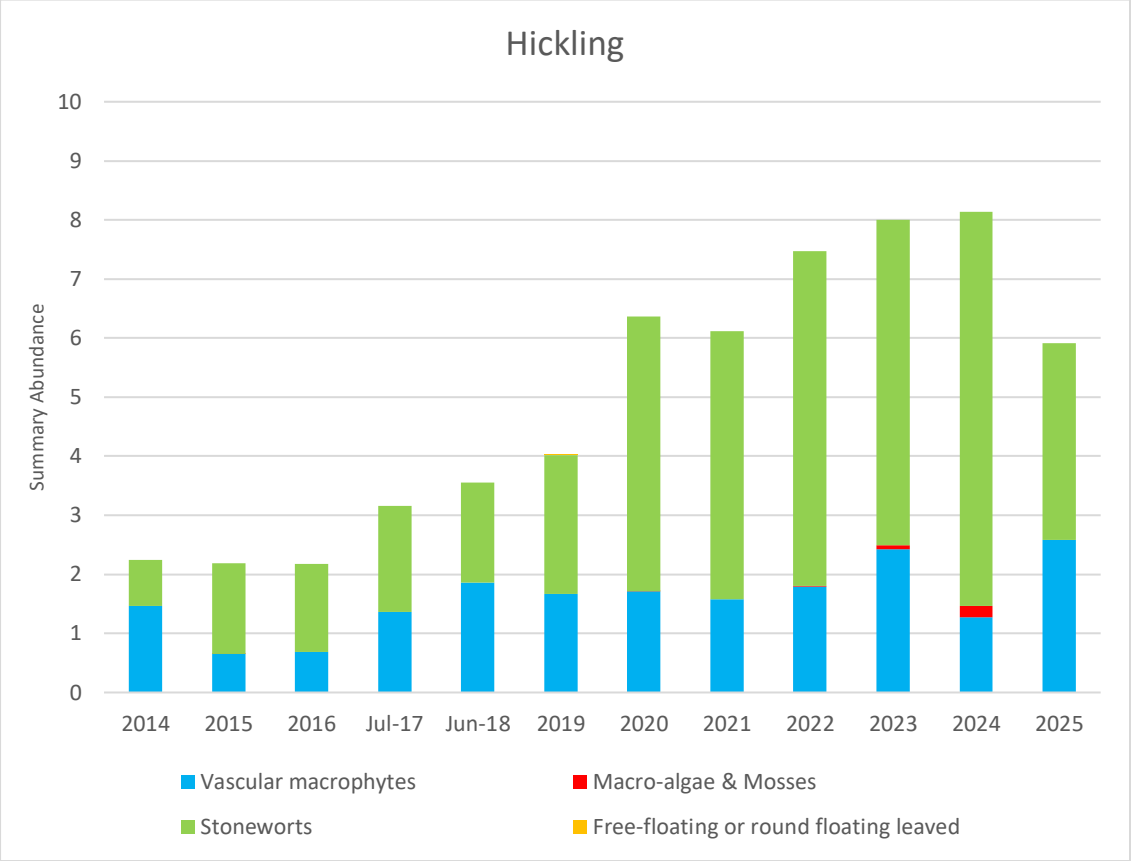
Common Name	Scientific Name	Summary Abundance	Occurrences
Intermediate stonewort	*C. intermedia*	2.754	49
Spiked water milfoil	*Myriophyllum spicatum*	1.373	61
Fennel-leaved pondweed	*P. pectinatus*	0.676	23
Holly-leaved naiad	*Najas marina*	0.278	12
Baltic stonewort	*C. baltica*	0.204	17
Hedgehog stonewort	*C. aculeolata*	0.150	2
Rigid hornwort	*Ceratophyllum demersum*	0.116	11
Rough stonewort	*C. aspera*	0.113	7
Mare's tail	*Hippuris vulgaris*	0.100	2
Starry stonewort	*Nitellopsis obtusa*	0.064	5
Lesser bearded stonewort	*C. curta*	0.050	3
Canadian waterweed	*Elodea canadensis*	0.025	2
Fan-leaved water crowfoot	*Ranunculus circinatus*	0.013	1

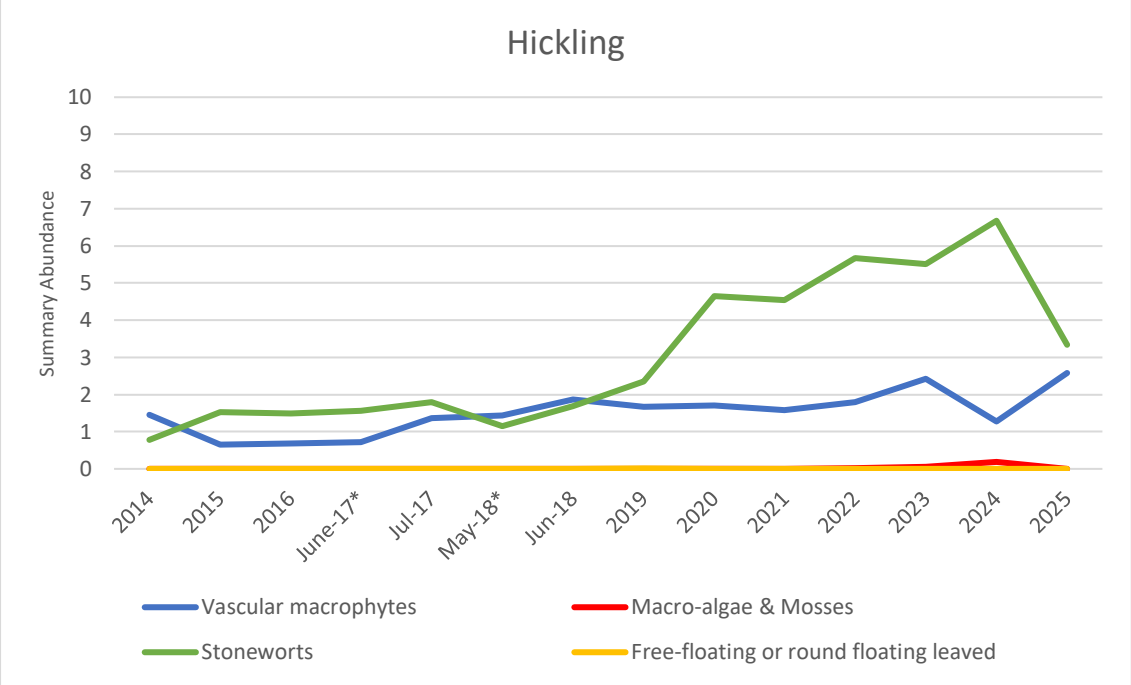
Common Name	Scientific Name	Summary Abundance	Occurrences
Stonewort (Chara) species	*Chara sp.*	0.003	2
No plants	*No plants*	0.000	1
Total number of species recorded		**14**	**Total samples taken: 80**

This year the summary abundance within Hickling decreased from 8.140 to 5.916. Intermediate stonewort decreased from 4.813 to 2.754. which explains the drop seen in the Stonewort summary abundance. Baltic stonewort decreased from 0.864 with 31 occurrences to 0.204 to 17 occurrences. Spiked water milfoil increased from 0.864 with 23 occurrences to 1.373 with 61 occurrences.

Graph 8 & 9

Hickling Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Horsey

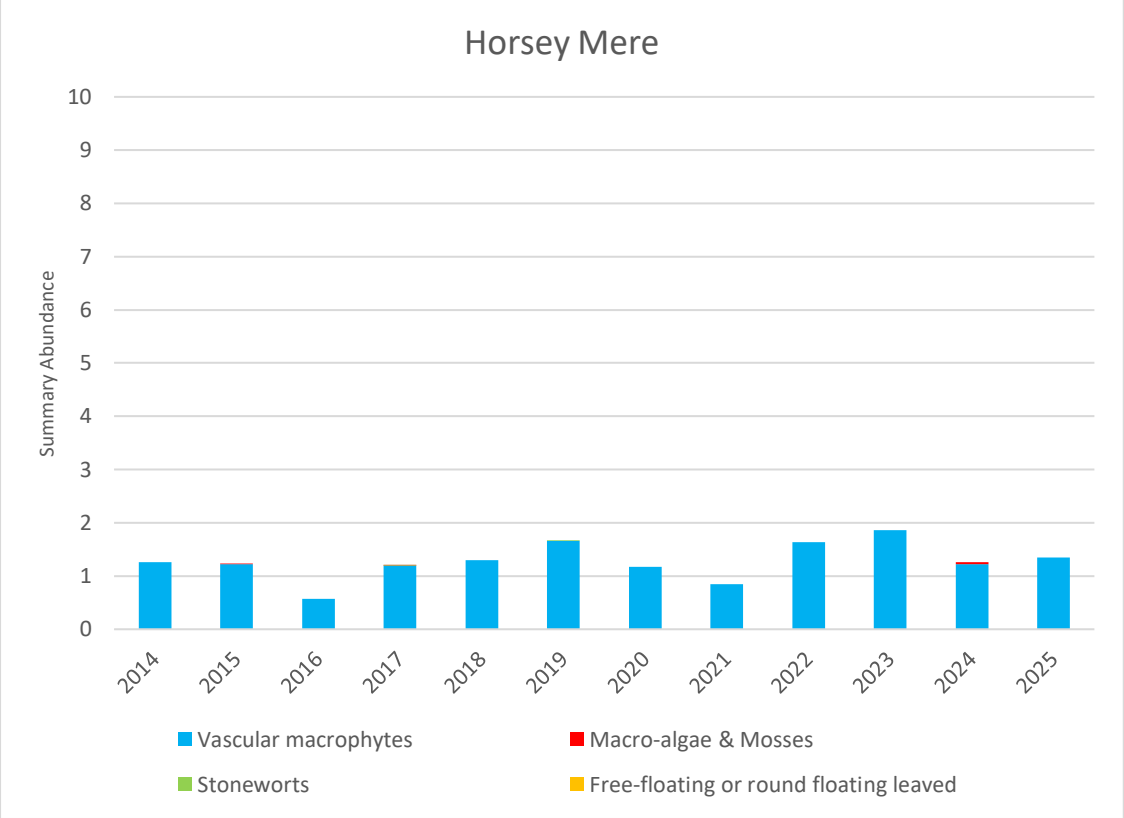
Table 6

Common Name	Scientific Name	Summary Abundance	Occurrences
Spiked water milfoil	*Myriophyllum spicatum*	1.062	27
Mare's tail	*Hippuris vulgaris*	0.274	16
Fennel-leaved pondweed	*P. pectinatus*	0.015	1
Common reed	*Phragmites australis*	0.002	1
No plants	*No plants*	0.000	39
Total number of species recorded		**4**	**Total samples taken: 66**

Overall summary abundance remained the same as that recorded in 2024. Spiked water milfoil increased from 0.395 to 1.062, with 21 occurrences increasing to 27, whereas Mare's tail decreased from 0.439 to 0.274.

Graph 10

Horsey Mere summary abundance shown in plant groups (see Appendix 1 for more detail)



Martham North

Table 7

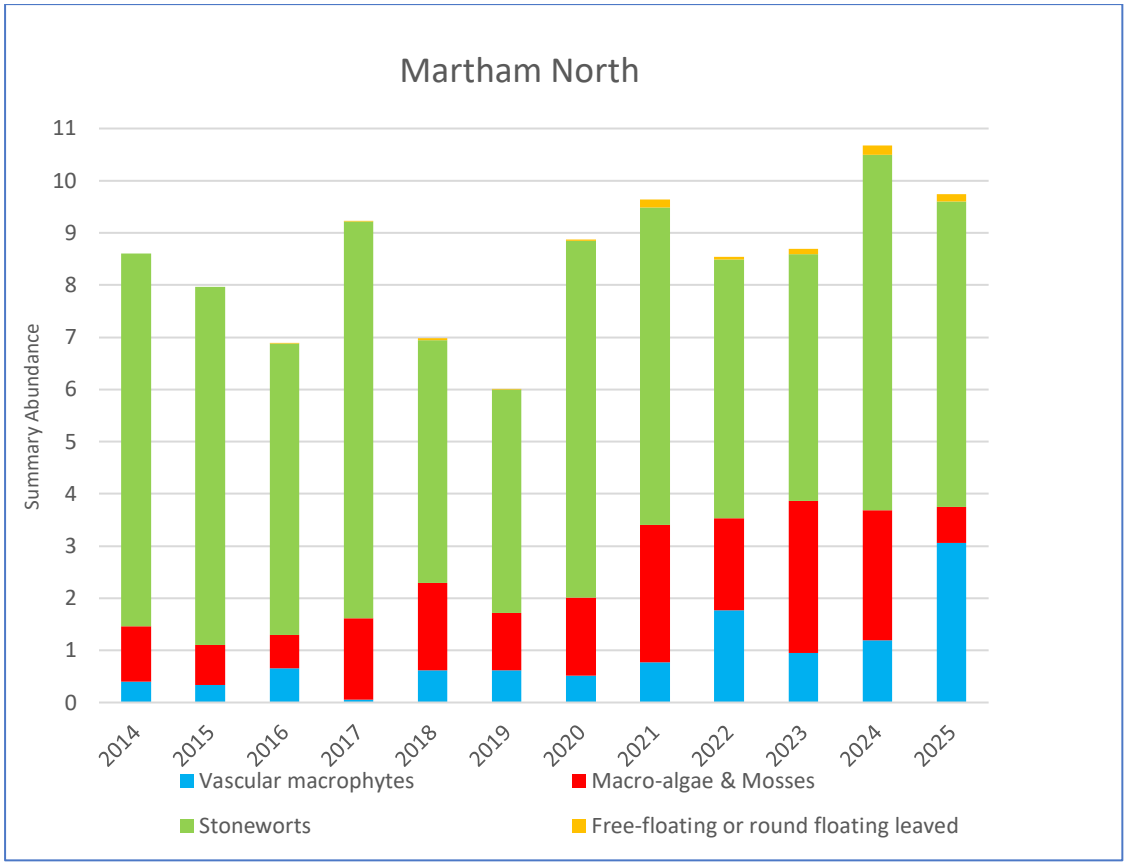
Common Name	Scientific Name	Summary Abundance	Occurrences
Intermediate stonewort	*C. intermedia*	3.021	30
Bristly stonewort	*C. hispida*	2.625	37
Fennel-leaved pondweed	*P. pectinatus*	2.479	18
Zygnematales	*Filamentous algae*	0.648	8
Spiked water milfoil	*Myriophyllum spicatum*	0.375	2
Baltic stonewort	*C. baltica*	0.208	10
Intermediate water-starwort	*Callitriche stagnalis*	0.208	1
Ivy-leaved duckweed	*Lemna trisulca*	0.092	8
Common water moss	*Fontinalis antipyretica*	0.042	2
White water lily	*Nymphaea alba*	0.042	1
Yellow water lily	*Nuphar lutea*	0.002	1
Total number of species recorded		**11**	**Total samples taken: 48**

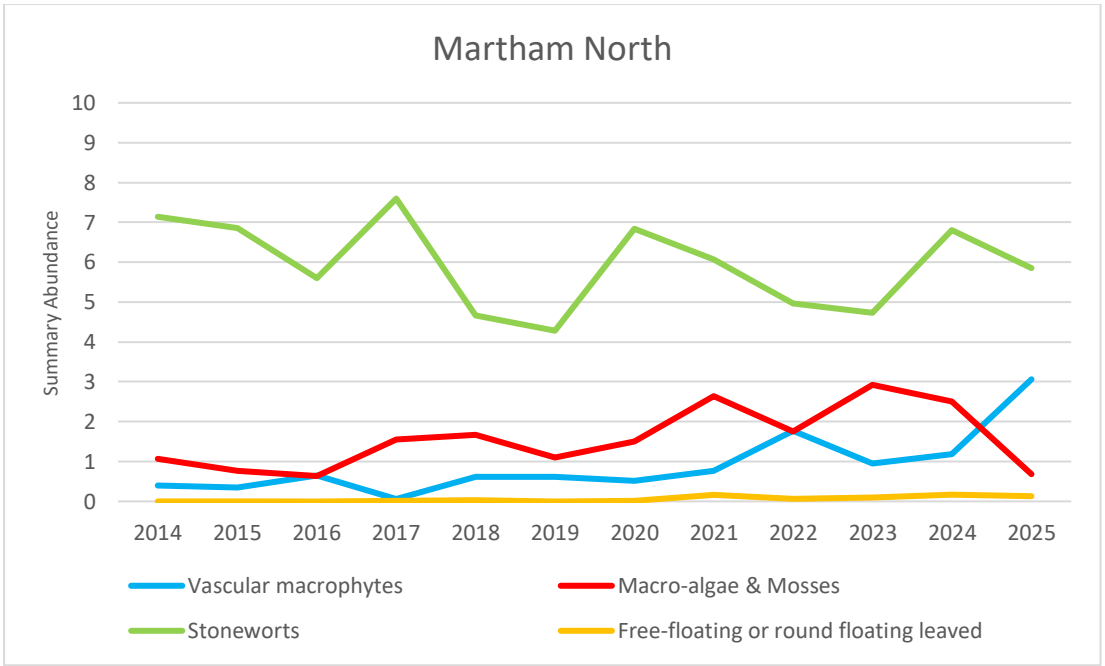
Overall abundance decreased slightly in 2025 from 10.671 to 9.742. Intermediate stonewort increased and has overtaken Bristly stonewort to be the most abundant species . Vascular macrophytes increased in overall summary abundance with Fennel-leaved pondweed and Spiked water milfoil increasing in abundance this year.

Two points were not recorded owing to Filamentous algae causing access difficulties. From observation, it is assumed that these points would be close to 100% Filamentous algae. If these two points were included in the overall total Filamentous algae would be 1.360 instead if the 0.648 recorded.

Graph 11 & 12

Martham North Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Martham South

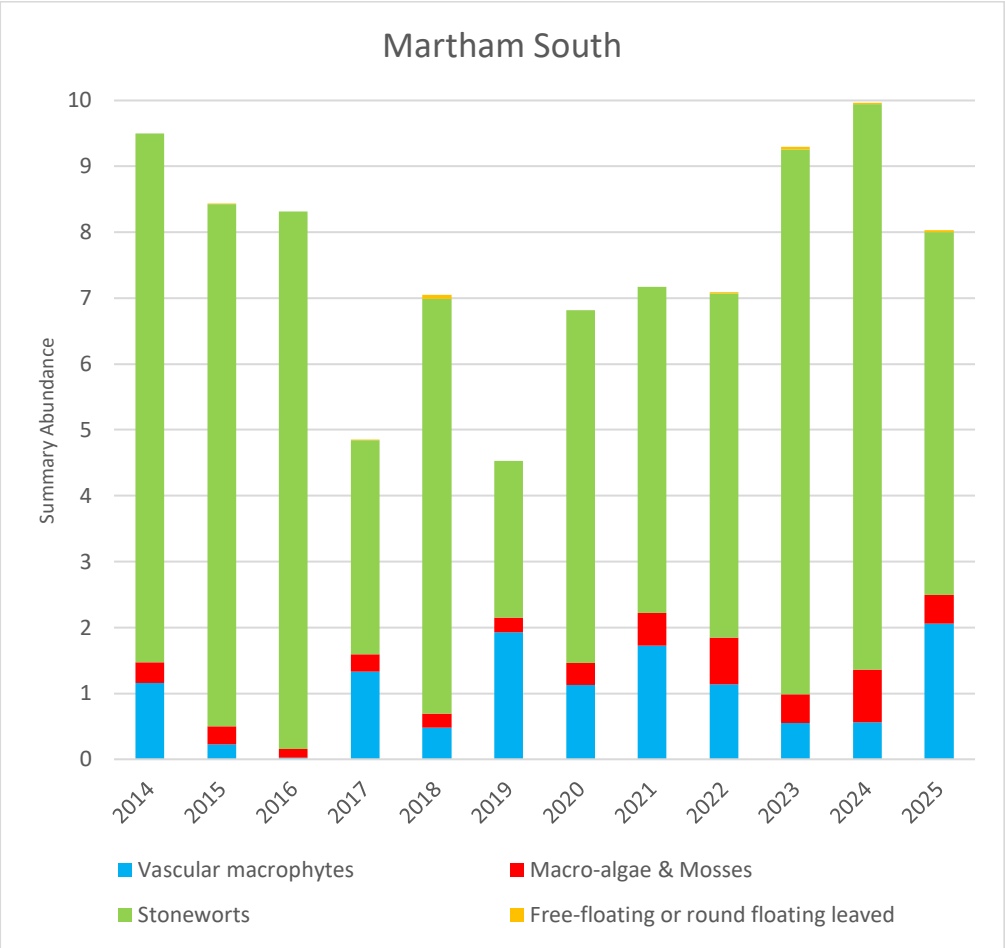
Table 8

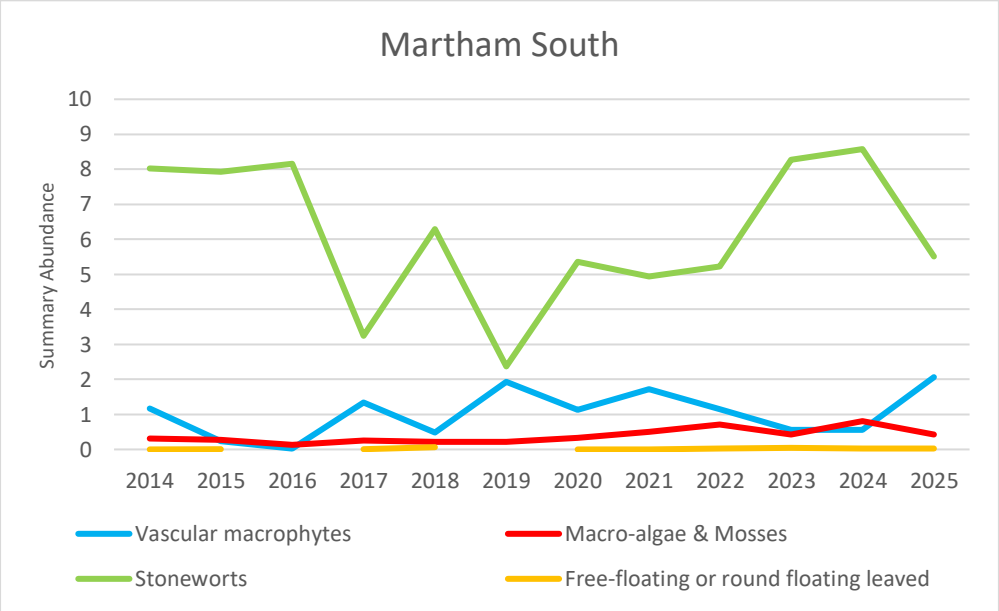
Common Name	Scientific Name	Summary Abundance	Occurrences
Intermediate stonewort	*C. intermedia*	2.483	35
Bristly stonewort	*C. hispida*	2.173	32
Fennel-leaved pondweed	*P. pectinatus*	1.194	21
Common water moss	*Fontinalis antipyretica*	0.408	10
Baltic stonewort	*C. baltica*	0.275	17
Holly-leaved naiad	*Najas marina*	0.271	8
Common stonewort	*C. vulgaris*	0.269	9
Mare's tail	*Hippuris vulgaris*	0.269	4
Spiked water milfoil	*Myriophyllum spicatum*	0.212	6
Starry stonewort	*Nitellopsis obtusa*	0.177	10
Rough stonewort	*C. aspera*	0.096	3
Rigid hornwort	*Ceratophyllum demersum*	0.096	2
Fragile/convergent stonewort	*C. globularis/connivens*	0.040	3
Ivy-leaved duckweed	*Lemna trisulca*	0.023	3
Zygnematales	*Filamentous algae*	0.021	2
Canadian waterweed	*Elodea canadensis*	0.021	2
Total number of species recorded		**16**	**Total samples taken: 52**

Martham South Broad recorded an overall decrease in abundance from 9.963 in 2024 to 8.029. However, Intermediate stonewort recorded an increase with an overall decrease in the abundance of stoneworts as a group. Overall, the proportion of vascular macrophytes doubled and macro-algae & mosses decreased.

Graph 13 & 14

Martham South Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Ant Valley

In the Ant Valley, Alderfen, Barton Broad and Cromes were some of the first broads to be surveyed, starting in 1983 and have been regularly surveyed since. These water bodies have been subject to extensive restoration effort over the last 25 years and have all experienced improvements to water quality.

2025 Summary

2025 has seen Alderfen , Catfield and Cromes increase in overall abundance. Reedham water has decreased and Barton Broad abundance is similar to 2024.

Alderfen

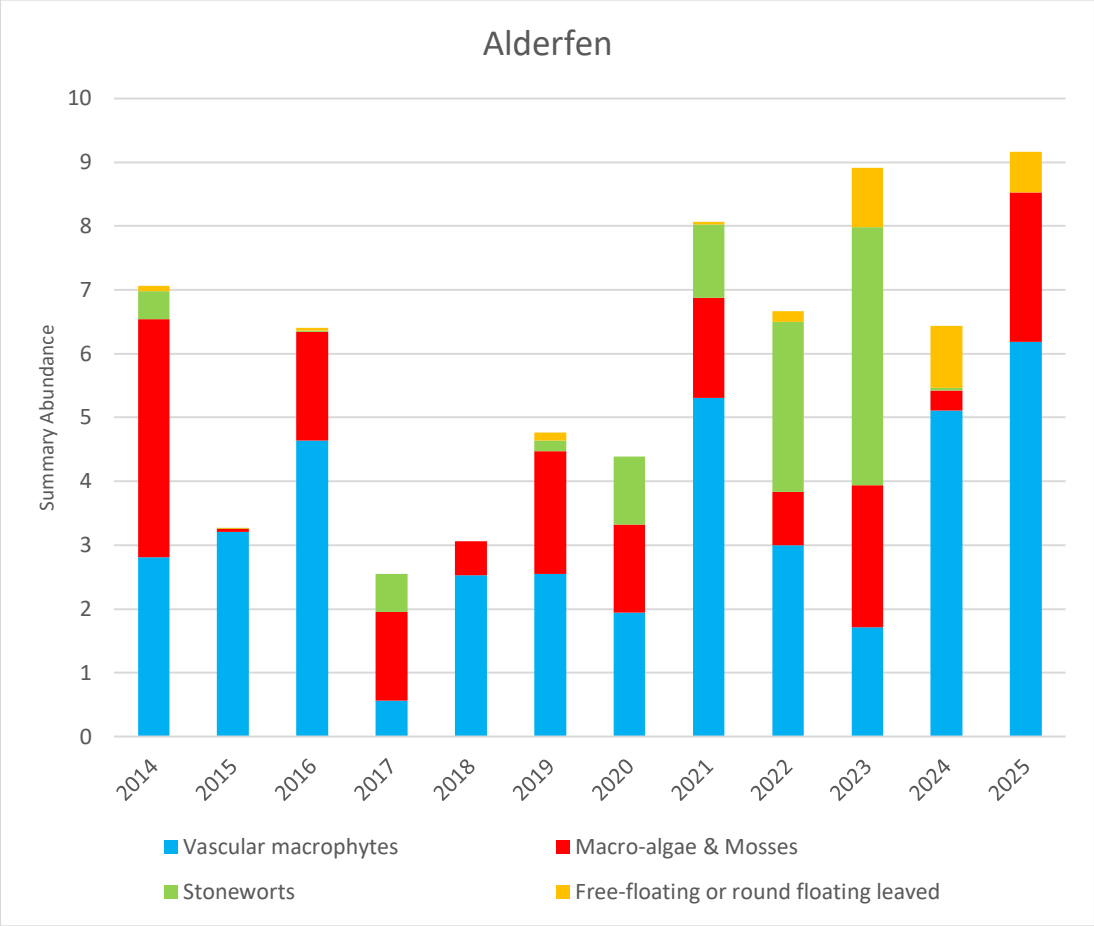
Table 9

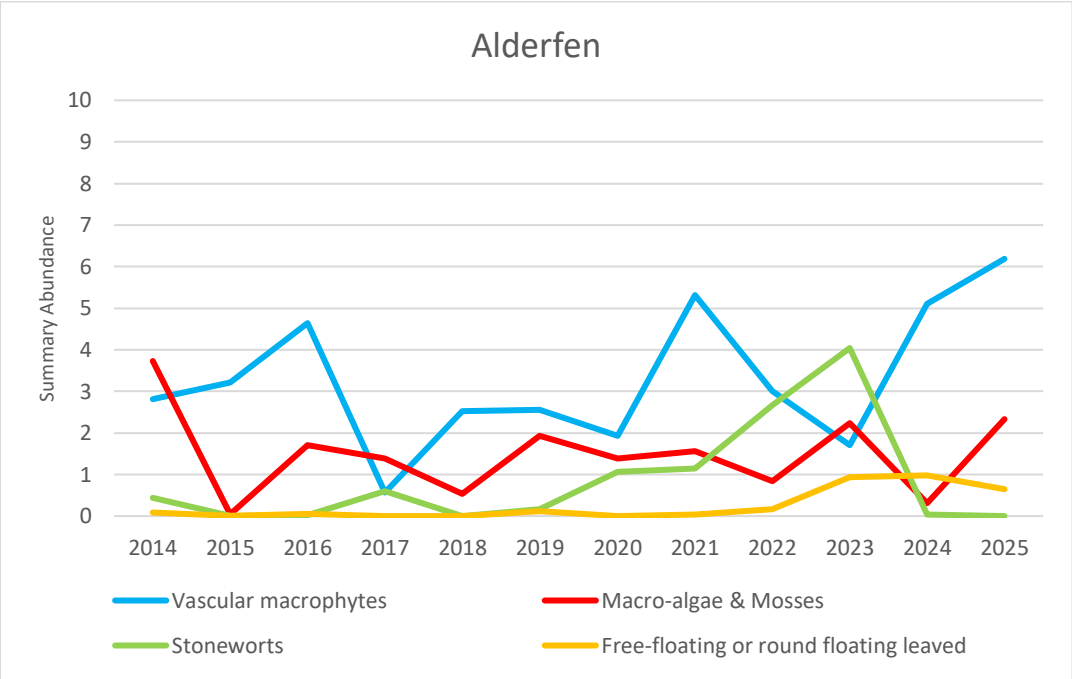
Common Name	Scientific Name	Summary Abundance	Occurrences
Rigid hornwort	*Ceratophyllum demersum*	3.917	51
Filamentous algae	*Zygnematales*	2.338	30
Holly-leaved naiad	*Najas marina*	2.229	45
Ivy-leaved duckweed	*Lemna trisulca*	0.640	36
Horned pondweed	*Zannichellia palustris*	0.042	2
Total number of species recorded		**5**	**Total samples taken: 48**

Alderfen has seen an overall increase in summary abundance. Holly-leaved naiad increased (0.917 to 2.229) along with Filamentous algae (0.313 to 2.338). Rigid hornwort abundance was similar to 2024 and Stoneworts were not recorded.

Graph 15 & 16

Alderfen Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





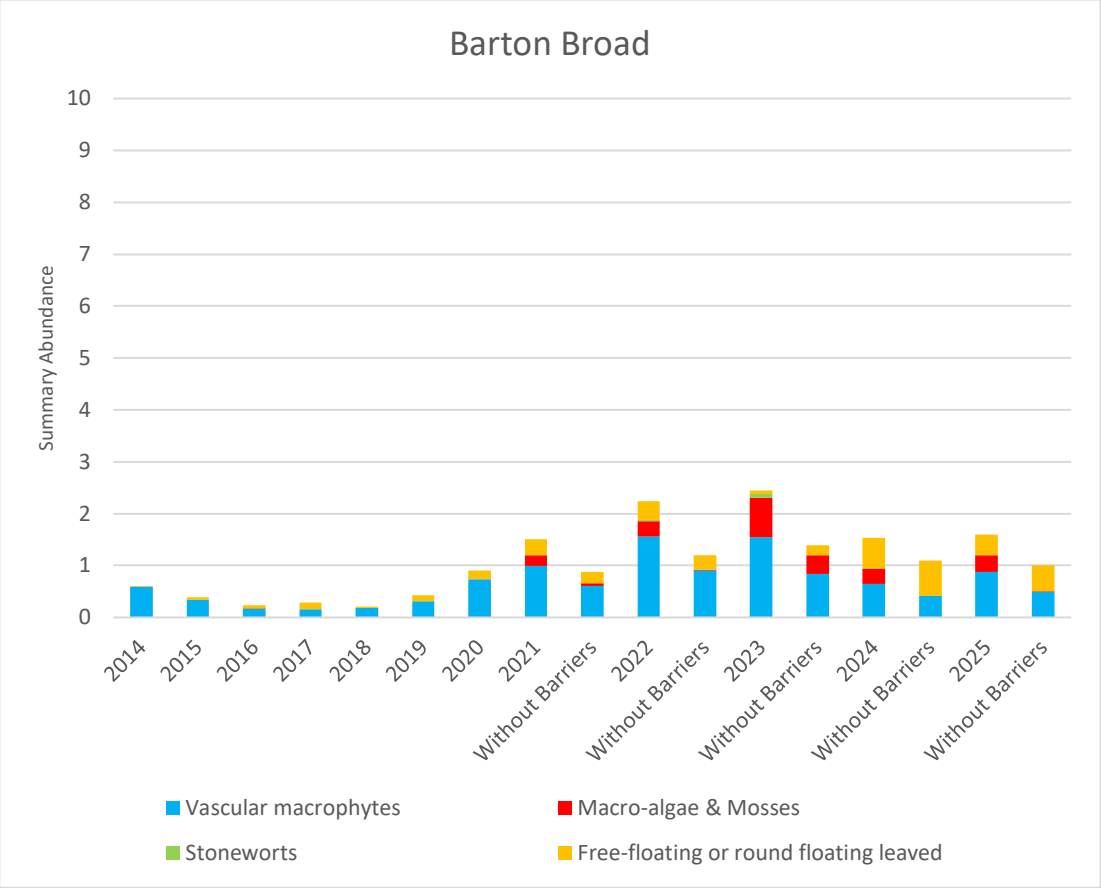
Barton Broad
Table 10

Common Name	Scientific Name	Summary Abundance	Occurrences
Rigid hornwort	*Ceratophyllum demersum*	0.652	19
Filamentous algae	*Zygnematales*	0.317	8
White water lily	*Nymphaea alba*	0.209	2
Yellow water lily	*Nuphar lutea*	0.198	3
Fennel-leaved pondweed	*P. pectinatus*	0.142	14
Spiked water milfoil	*Myriophyllum spicatum*	0.035	2
Nuttall's waterweed	*Elodea nuttallii*	0.012	1
Shining pondweed	*P. lucens*	0.012	1
Fan-leaved water crowfoot	*Ranunculus circinatus*	0.012	1
Greater reedmace	*Typha latifollia*	0.012	1
Canadian waterweed	*Elodea canadensis*	0.001	1
No plants	*No plants*	0.000	52
Total number of species recorded		**11**	**Total samples taken: 88 (with Barriers) ; 72 (without Barriers)**

Barton Broad had an overall summary abundance similar to that recorded in 2024. Species number increased from 4 to 11. Freshwater mussel species were observed again this year including duck, swan, painters and zebra mussels. Summary abundance within and outside the fish barriers were similar.

Graph 17

Barton Broad summary abundance shown in plant groups (see Appendix 1 for more detail)



Catfield Broad

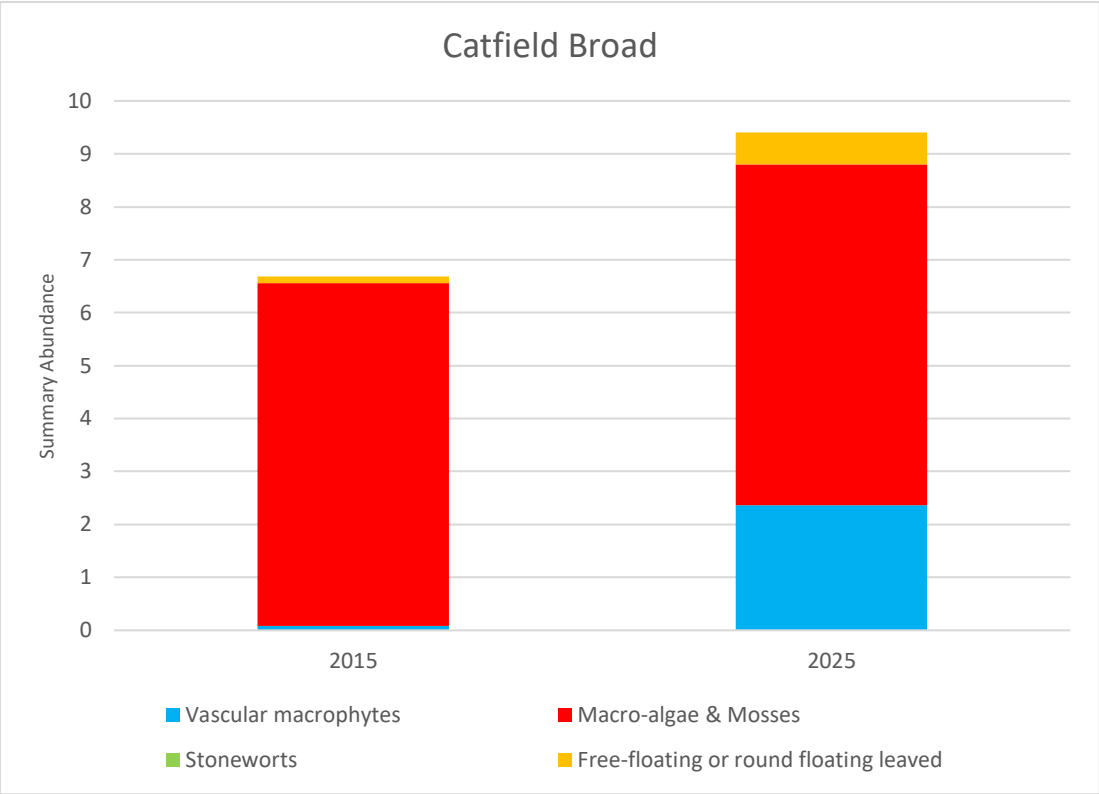
Table 11

Common Name	Scientific Name	Summary Abundance	Occurrences
Filamentous algae	*Zygnematales*	6.433	27
Rigid hornwort	*Ceratophyllum demersum*	2.367	14
Frogbit	*Hydrocharis morsus-ranae*	0.500	2
Ivy-leaved duckweed	*Lemna trisulca*	0.067	2
Common duckweed	*Lemna minor*	0.037	2
Total number of species recorded		**5**	**Total samples taken: 30**

Catfield Broad is an interesting water body. Mainly covered by Filamentous algae and Rigid hornwort however, white water lilies were growing along the edge and the water was very clear. Filamentous algae abundance has not changed in the last 10 years however the abundance of Rigid hornwort has increased (0.083 to 2.367) along with the occurrences (6 to 14). Frogbit was last seen in 2006 and common duckweed was last seen in 2009.

Graph 18

Catfield Broad summary abundance shown in plant groups (see Appendix 1 for more detail)



Cromes Broad

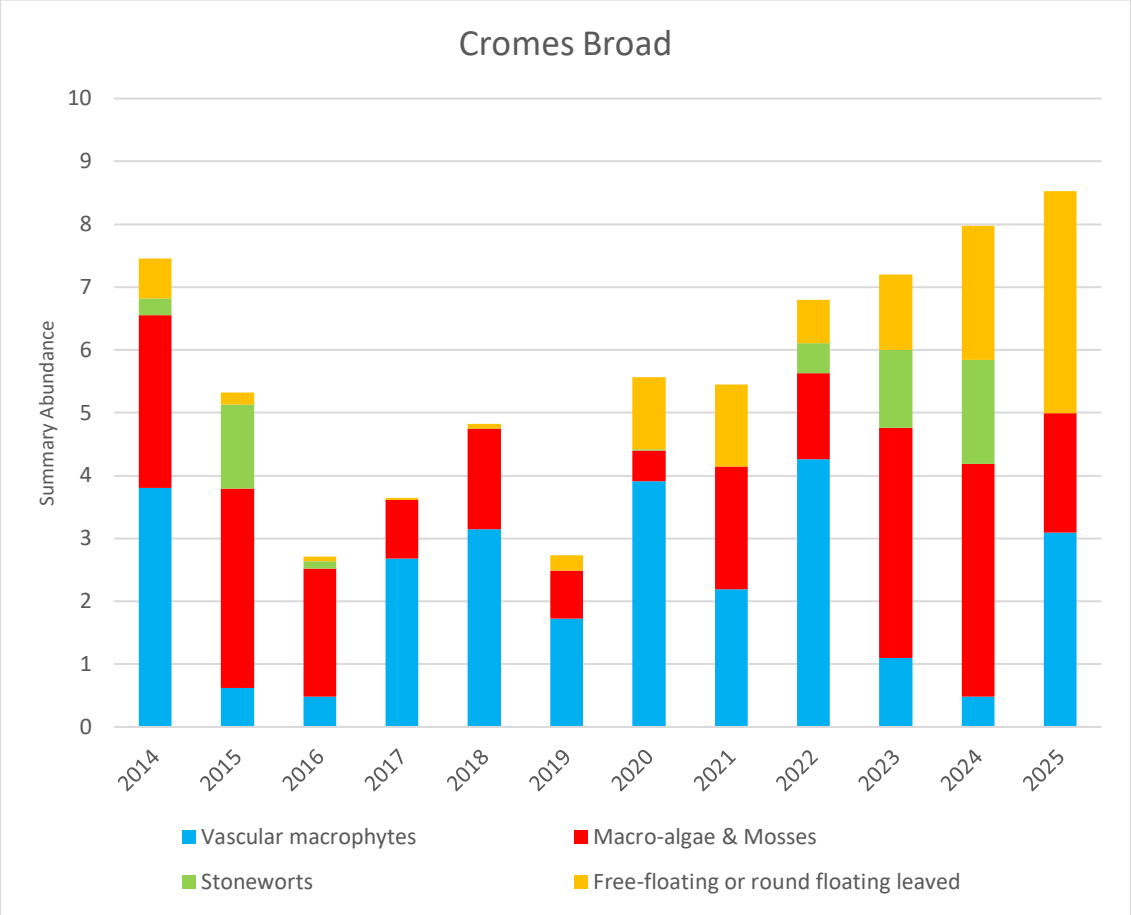
Table 12

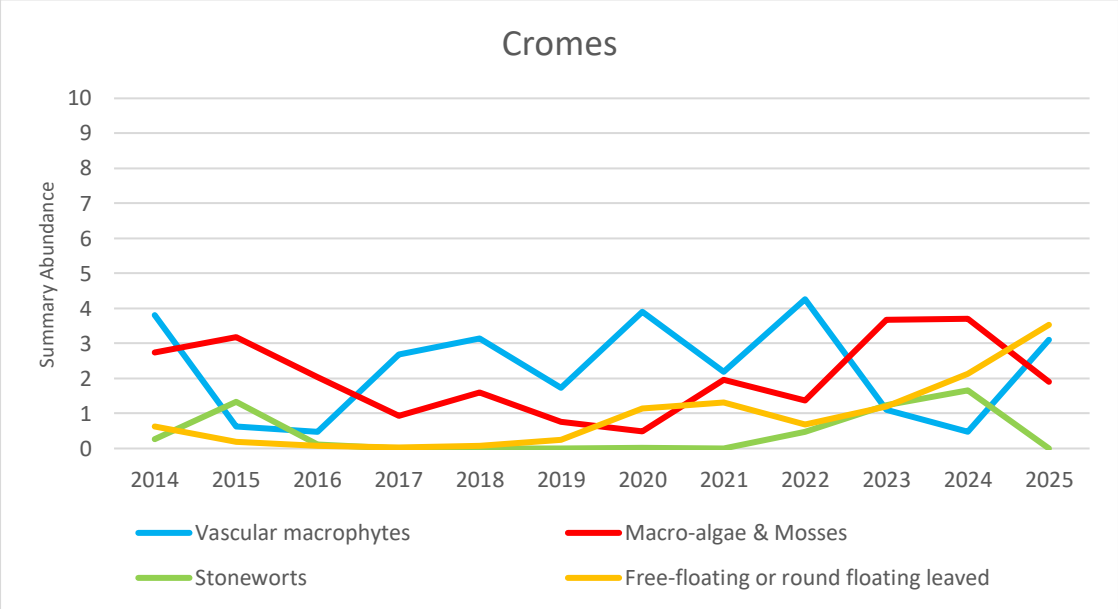
Common Name	Scientific Name	Summary Abundance	Occurrences
Filamentous algae	*Zygnematales*	1.898	42
Rigid hornwort	*Ceratophyllum demersum*	1.705	23
White water lily	*Nymphaea alba*	1.502	12
Holly-leaved naiad	*Najas marina*	1.073	14
Greater duckweed	*Spirodela polyrhiza*	0.830	22
Common duckweed	*Lemna minor*	0.648	23
Ivy-leaved duckweed	*Lemna trisulca*	0.370	18
Nuttall's waterweed	*Elodea nuttallii*	0.250	4
Yellow water lily	*Nuphar lutea*	0.114	1
Frogbit	*Hydrocharis morsus-ranae*	0.045	2
Horned pondweed	*Zannichellia palustris*	0.045	2
Least duckweed	*Lemna minuta*	0.023	1
Bladderwort	*Utricularia vulgaris*	0.023	1
Total number of species recorded		**13**	**Total samples taken: 44**

There was a large increase in vascular plants within Cromes Broad this year, mostly Rigid hornwort and Holly-leaved naiad. Rigid hornwort increased in occurrences from 16 to 23, and abundance increased from 0.455 to 1.705. Holly-leaved naiad presence and abundance was notable this year with 14 occurrences. Filamentous algae decreased substantially from 3.477 to 1.898. White water lily had similar numbers to last year. Bladderwort only occurred once this year compared to 6 occurrences last year.

Graph 19 & 20

Cromes Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Reedham Water

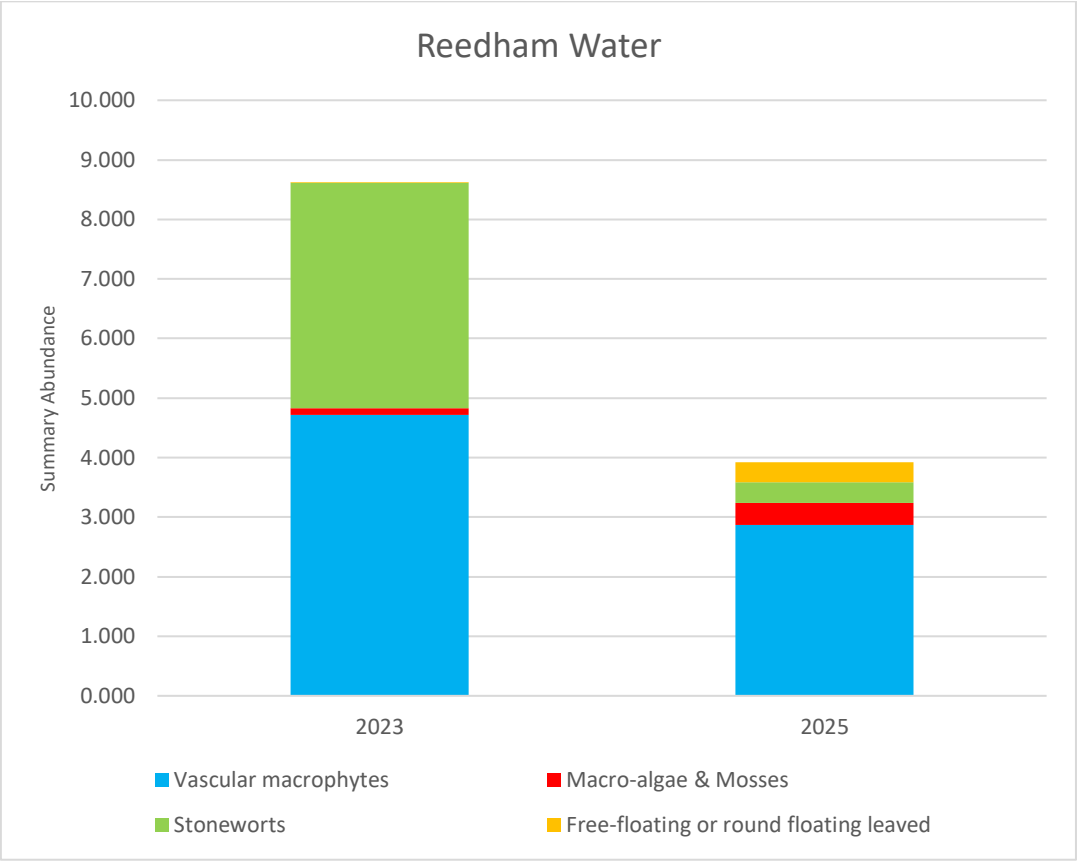
Table 13

Common Name	Scientific Name	Summary Abundance	Occurrences
Holly-leaved naiad	*Najas marina*	1.696	33
Rigid hornwort	*Ceratophyllum demersum*	0.957	33
Ivy-leaved duckweed	*Lemna trisulca*	0.328	16
Common stonewort	*C. vulgaris*	0.326	14
Filamentous algae	*Zygnematales*	0.239	8
Fennel-leaved pondweed	*P. pectinatus*	0.176	9
Enteromorpha	*Enteromorpha*	0.130	6
Nuttall's waterweed	*Elodea nuttallii*	0.043	2
Delicate stonewort	*C. virgata*	0.024	2
No plants	*No plants*	0.000	2
Total number of species recorded		**9**	**Total samples taken: 46**

2025 recorded a reduction in overall summary abundance. Holly-leaved naiad was still the prominent species even though it reduced in abundance (3.696 to 1.696). A reduction was also seen in stoneworts, whereas free-floating or round floating leaved plants and macro algae and mosses increased.

Graph 21

Reedham Water summary abundance shown in plant groups separetly (see Appendix 1 for more detail)



Bure Valley

In recent years, Upton and Cockshoot Broads, both isolated from the river, have been a stronghold for the rare Holly-leaved naiad. Conversely, those broads directly connected to the river, such as Wroxham and Hoveton Great, have tended to have minimal plant diversity. This year, all the broads except Hoveton Great Broad have seen an increase in summary abundance.

Cockshoot

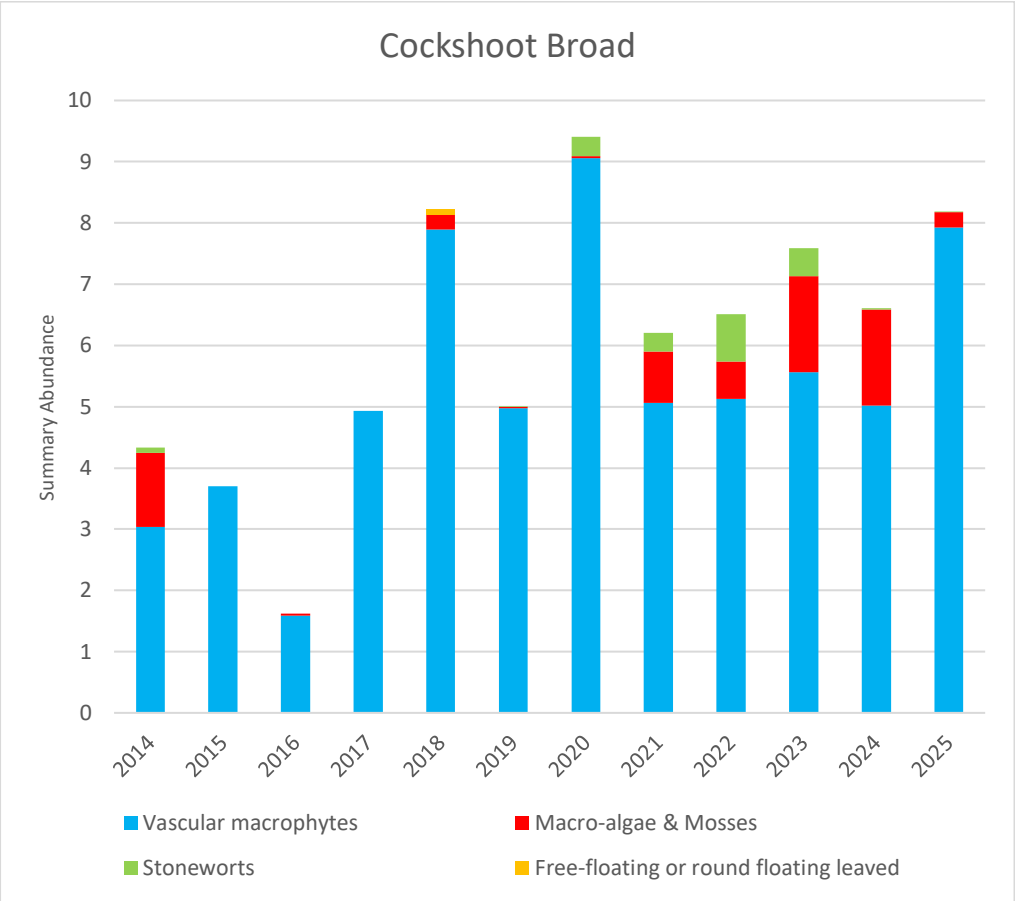
Table 14

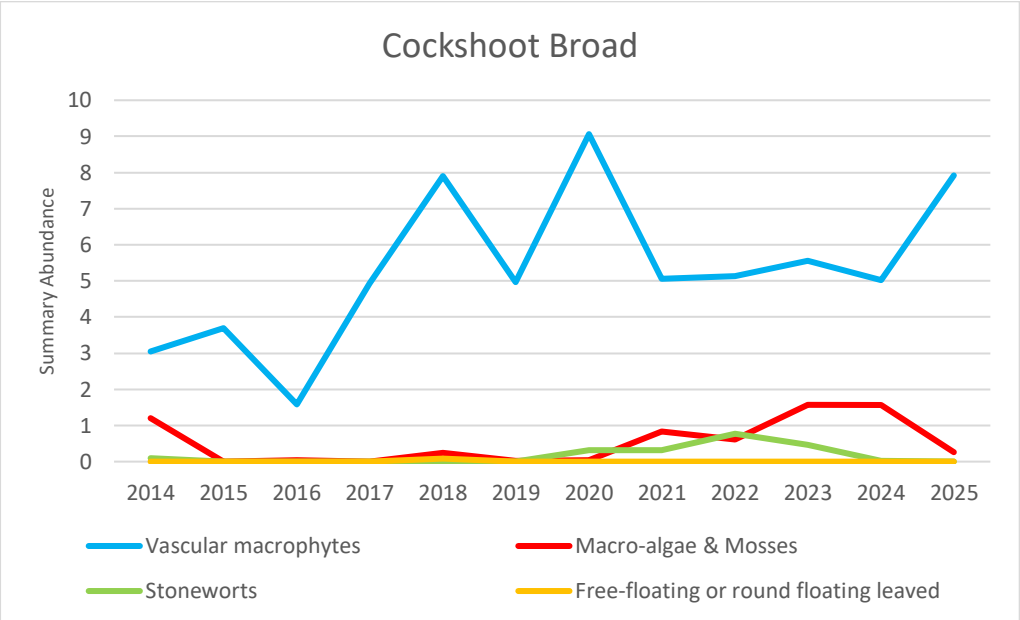
Common Name	Scientific Name	Summary Abundance	Occurrences
Holly-leaved naiad	*Najas marina*	6.131	45
Rigid hornwort	*Ceratophyllum demersum*	1.688	45
Filamentous algae	*Zygnematales*	0.208	19
Canadian waterweed	*Elodea canadensis*	0.104	5
Enteromorpha	*Enteromorpha*	0.046	4
Fragile/convergent stonewort	*C. globularis/connivens*	0.006	3
No plants	*No plants*	0.000	1
Total number of species recorded		**6**	**Total samples taken: 48**

This year, Cockshoot has seen an increase in vascular macrophytes although species number decreased from 8 in 2024 to 6 . Holly-leaved naiad increased in abundance (2.752 to 6.131) and occurrences (37 to 45). Rigid hornwort decreased from 2.125 to 1.688 and Filamentous algae from 1.463 to 0.208. White and yellow water lilies are present in the broad however they are not near a sample point and so do not get picked up on the survey.

Graph 22 & 23

Cockshoot Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Hoveton Great Broad

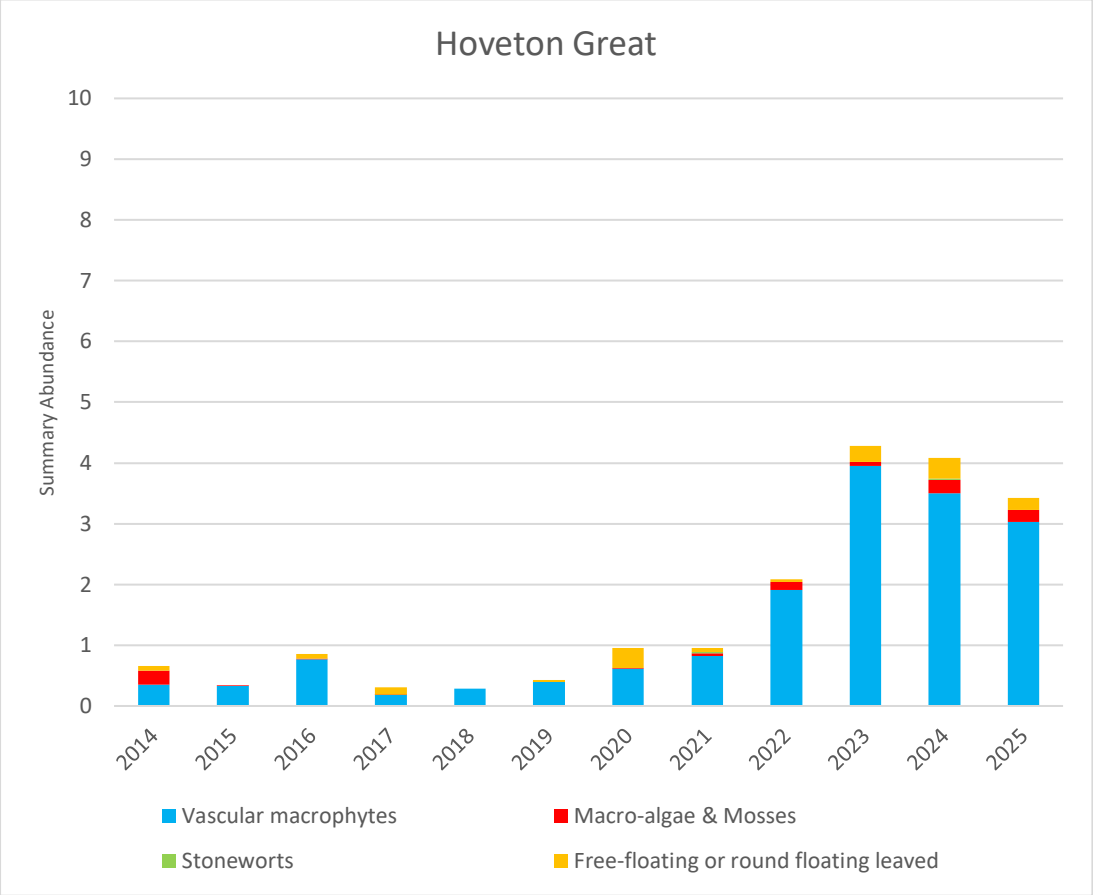
Table 15

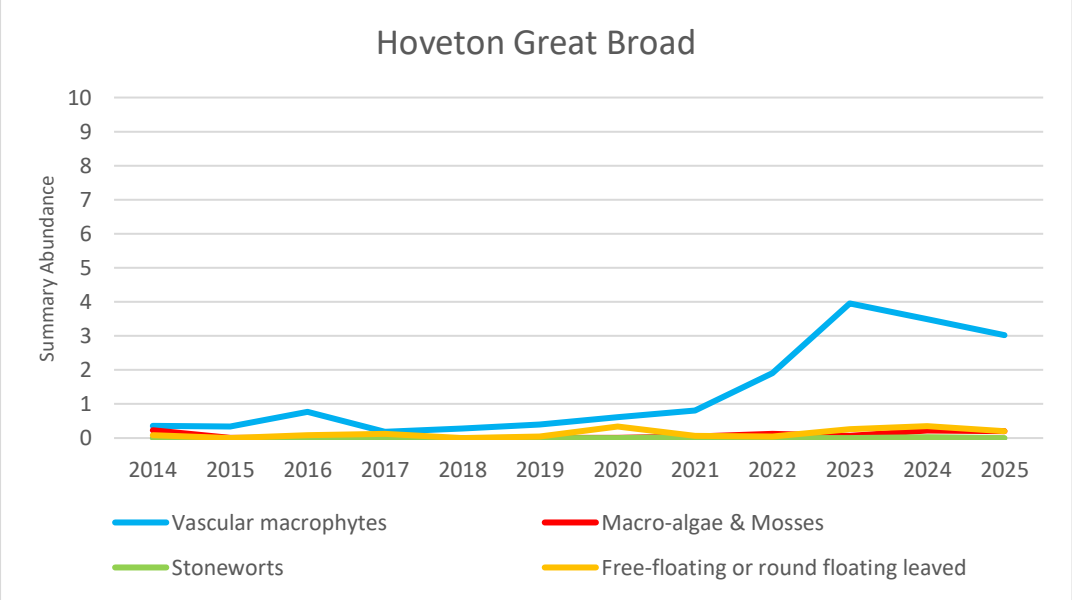
Common Name	Scientific Name	Summary Abundance	Occurrences
Nuttall's waterweed	*Elodea nuttallii*	1.294	34
Rigid hornwort	*Ceratophyllum demersum*	0.910	44
Canadian waterweed	*Elodea canadensis*	0.242	12
Filamentous algae	*Zygnematales*	0.202	16
Fennel-leaved pondweed	*P. pectinatus*	0.197	14
Yellow water lily	*Nuphar lutea*	0.194	4
Pondweed species	*Potamogeton sp.*	0.177	6
Horned pondweed	*Zannichellia palustris*	0.113	7
Arrowhead	*Saggitaria sagittifolia*	0.065	1
Long-stalked Pondweed	*Potamogeton praelongus*	0.032	1
Enteromorpha	*Enteromorpha*	0.002	1
No plants	No plants	0.000	11
Total number of species recorded		**11**	**Total samples taken: 60**

There has been a slight decrease in overall summary abundance in 2025 but species number has remained constant. Nuttall's waterweed increased (0.550 to 1.294) with occurrences staying very similar (32 to 34). Rigid hornwort decreased (1.800 to 0.910) whereas Filamentous algae had similar abundance scores but increased in occurrences (13 to 16). Three mussel species were found including Duck, Painters and Zebra throughout the survey. There are a few key places such as the eastern edge of the Broad near the new reedbed installations which continue to show encouraging signs of plants establishing in the area. Plants were seen at the surface of the water which is not usual for the broad (also seen last year), although the edges of the broad contain the most plants, with centre points remaining largely plant free and no plant scores totalling 11 occurrences. Long-stalked Pondweed (*Potamogeton praelongus*) was observed on the eastern end of the broad.

Graph 24 & 25

Hoveton Great Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





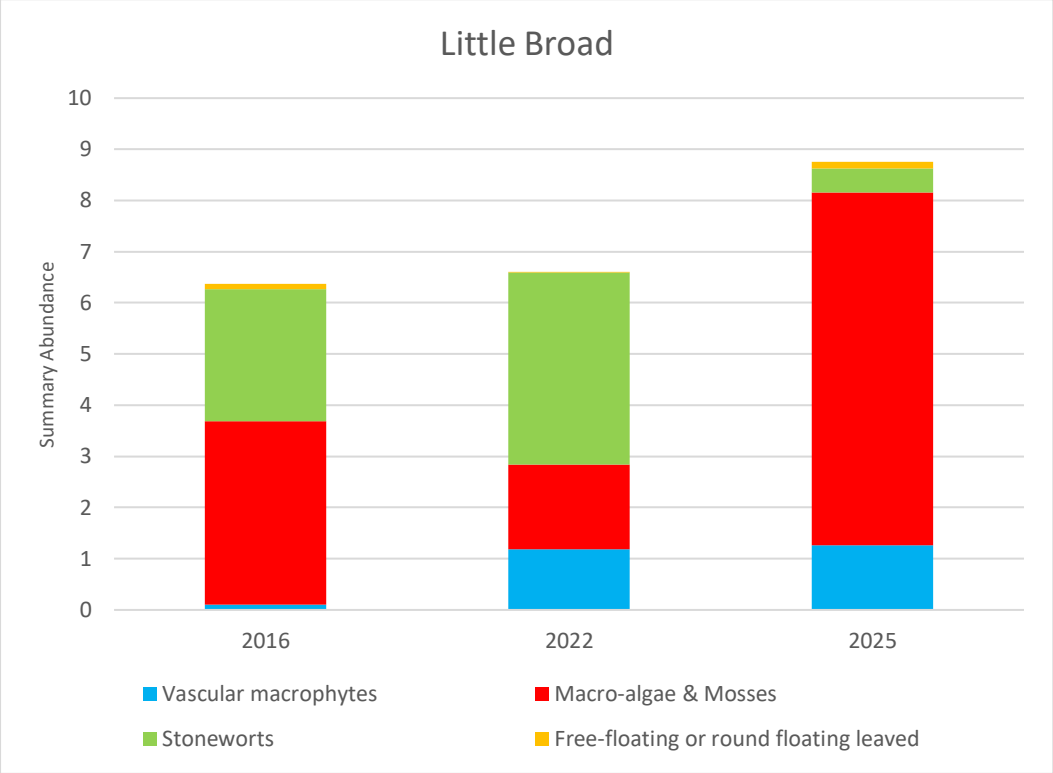
Little Broad

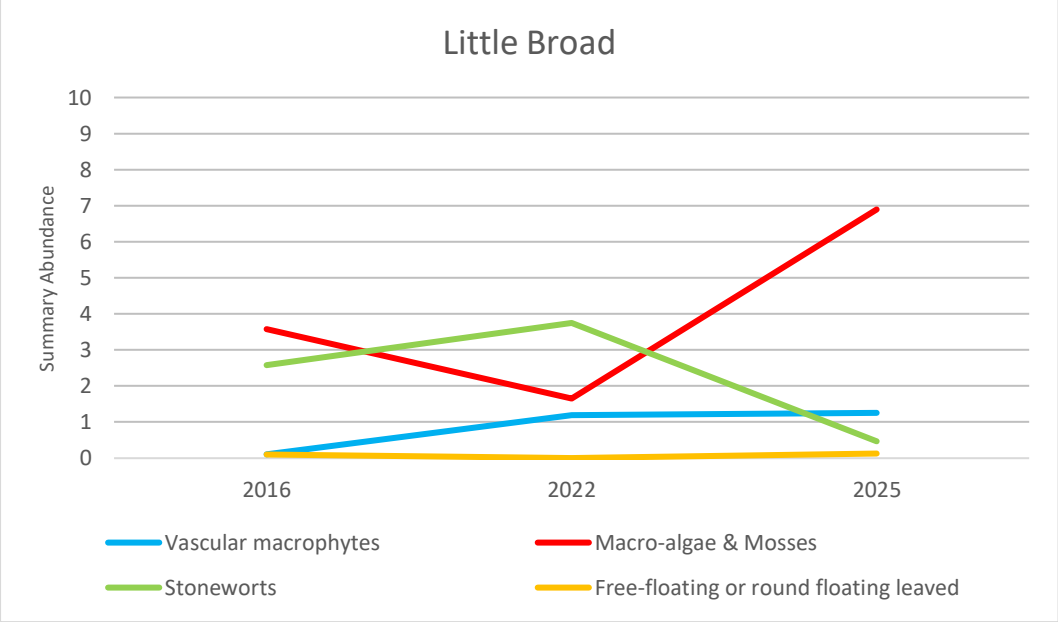
Table 16

Common Name	Scientific Name	Summary Abundance	Occurrences
Filamentous algae	*Zygnematales*	6.896	23
Holly-leaved naiad	*Najas marina*	1.043	26
Bristly stonewort	*C. hispida*	0.464	5
Fennel-leaved pondweed	*P. pectinatus*	0.143	4
Ivy-leaved duckweed	*Lemna trisulca*	0.129	9
Bladderwort	*Utricularia vulgaris*	0.071	2
Stonewort (Chara) species	*Chara sp.*	0.004	1
Total number of species recorded		**7**	**Total samples taken: 28**

2025 recorded an increased in macro-algae and mosses with vascular macrophytes staying similar to last year. Stoneworts had decreased but were still present. Holly-leaved naiad has seen a small increase in abundance (0.793 to 10.43) and occurrences (20 to 26). Bristly stonewort decreased in abundance (3.750 to 0.464) and occurrences (17 to 5).

Graph 26 & 27 Little Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Salhouse broad

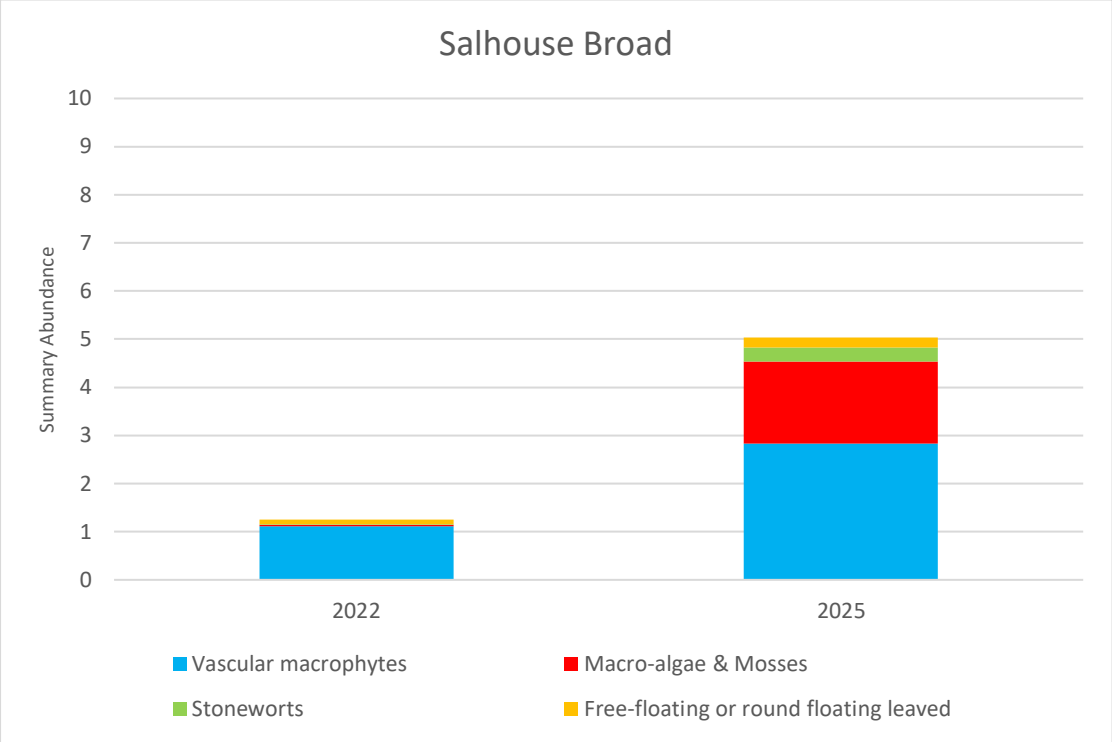
Table 17

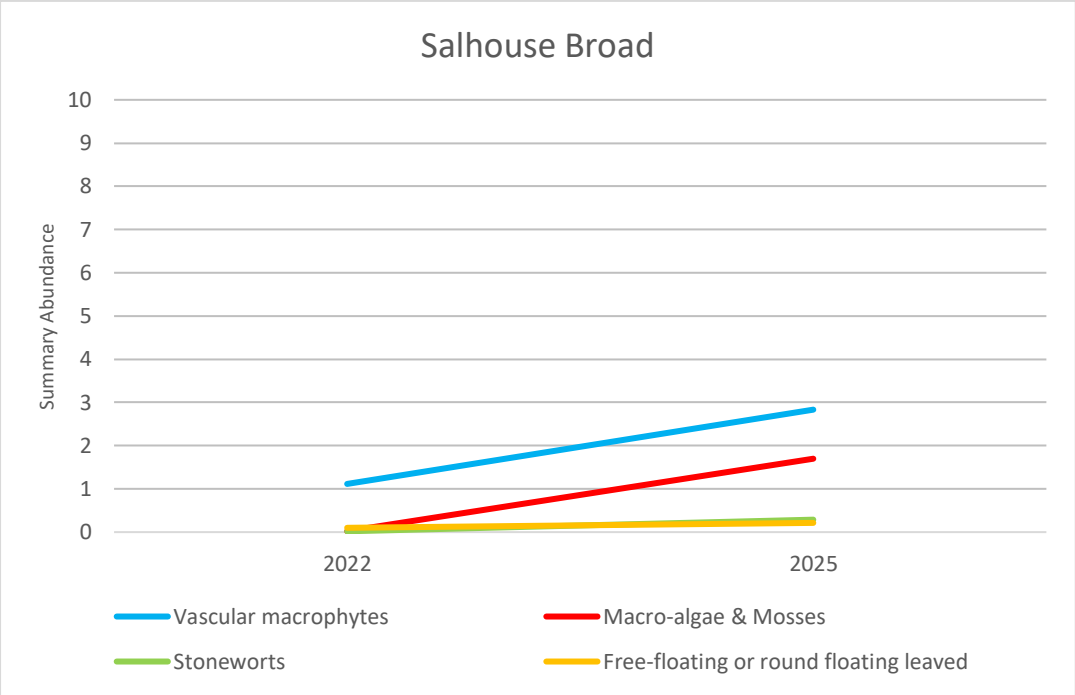
Common Name	Scientific Name	Summary Abundance	Occurrences
Filamentous algae	*Zygnematales*	1.638	45
Rigid hornwort	*Ceratophyllum demersum*	1.250	38
Nuttall's waterweed	*Elodea nuttallii*	1.002	34
Pointed stonewort	*Nitella mucronata*	0.288	14
Fennel-leaved pondweed	*P. pectinatus*	0.250	13
Yellow water lily	*Nuphar lutea*	0.213	7
Arrowhead	*Saggitaria sagittifolia*	0.192	8
Water net	*Hydrodictyon*	0.060	3
Whorled water milfoil	*Myriophyllum verticillatum*	0.058	2
Fan-leaved water crowfoot	*Ranunculus circinatus*	0.023	3
Spiked water milfoil	*Myriophyllum spicatum*	0.019	1
Unbranched bur-reed	*Sparganium emersum*	0.019	1
Long-stalked Pondweed	*Potamogeton praelongus*	0.019	1
Jelly algae	*Nostoc*	0.002	1
No plants	*No plants*	0.000	3
Total number of species recorded		**14**	**Total samples taken: 52**

2025 recorded increases in summary abundance and occurrence for a number of species. Increases in abundance and occurrences were seen in Filamentous algae (0.023 to 1.638) and (3 to 45), Rigid hornwort (0.673 to 1.250) and (23 to 38), Nuttall's water weed (0.058 to 1.002) and (3 to 34) and Pointed stonewort (0.019 to 0.288) and (1 to 14).

Graph 28 & 29

Salhouse Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Upton Great Broad

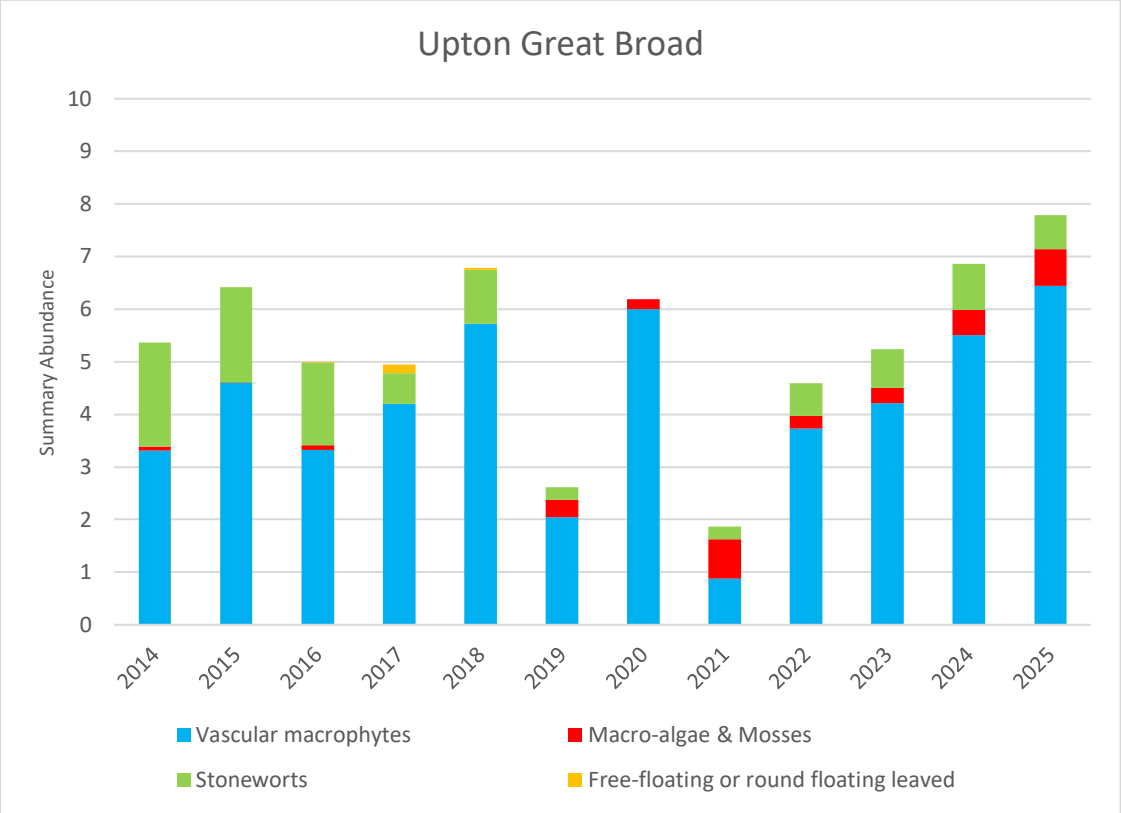
Table 18

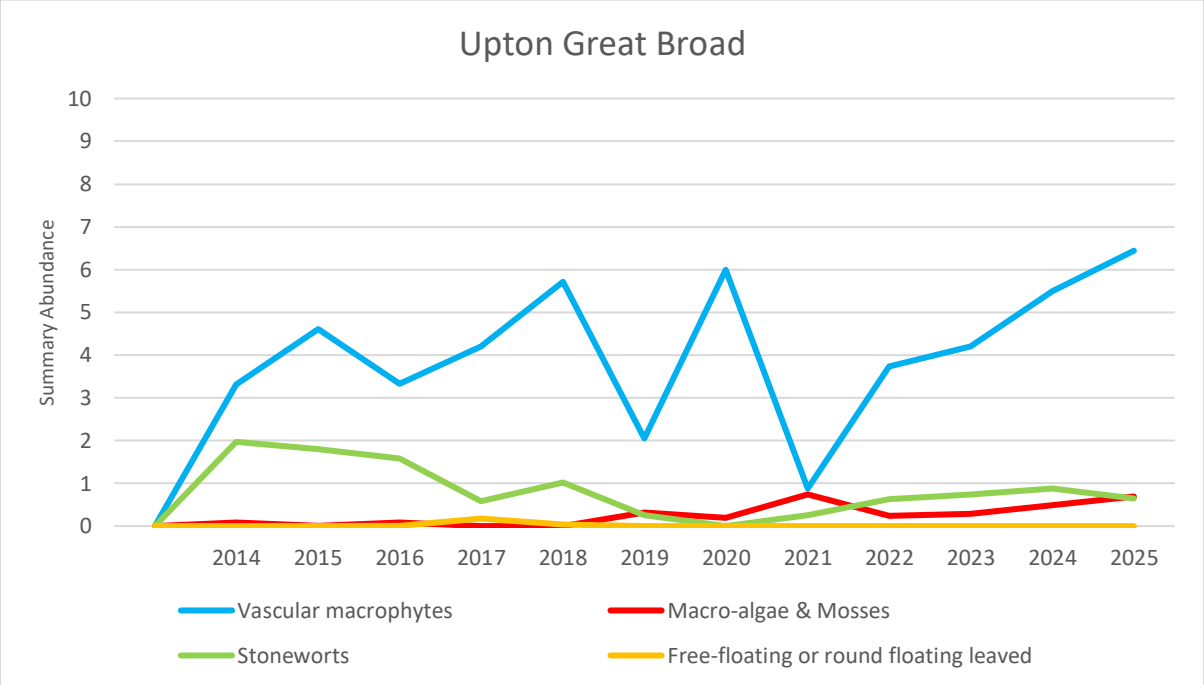
Common Name	Scientific Name	Summary Abundance	Occurrences
Holly-leaved naiad	*Najas marina*	6.442	42
Bristly stonewort	*C. hispida*	0.625	8
Filamentous algae	*Zygnematales*	0.423	17
Enteromorpha	*Enteromorpha*	0.273	5
Common stonewort	*C. vulgaris*	0.023	2
Fragile/convergent stonewort	*C. globularis/connivens*	0.002	1
Stonewort (Chara) species	*Chara sp.*	0.002	1
Total number of species recorded		**7**	**Total samples taken: 48**

2025 recorded an overall summary abundance increase from 6.858 to 7.790 and species number increase from 4 to 7. Holly-leaved naiad increased (5.500 to 6.442) and in occurrences (34 to 42). Bristly stonewort decreased from 0.852 to 0.625 but increased from 5 occurrences to 8. Filamentous remained fairly static and 'no plants' occurrences stayed at 0.

Graph 30 &31

Upton Great Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Upton Little broad

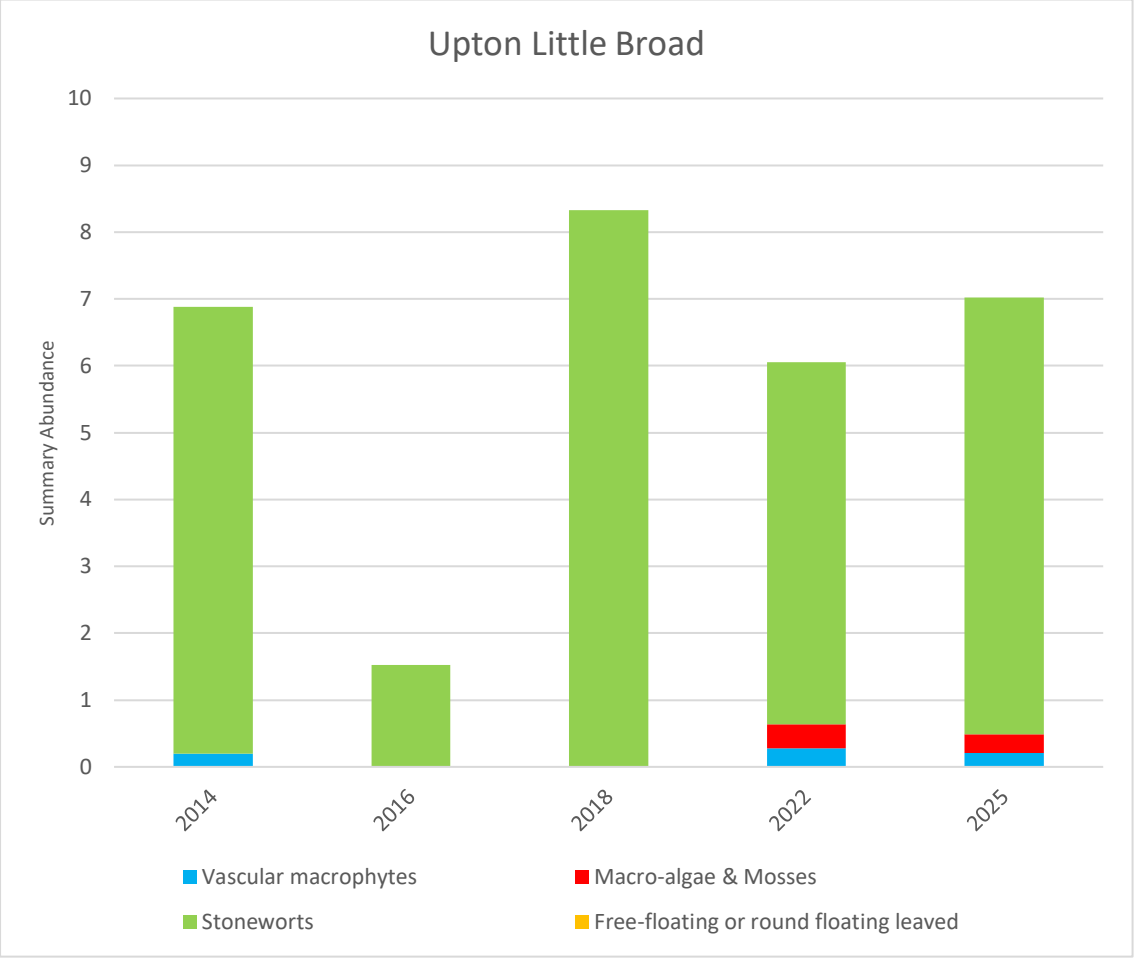
Table 19

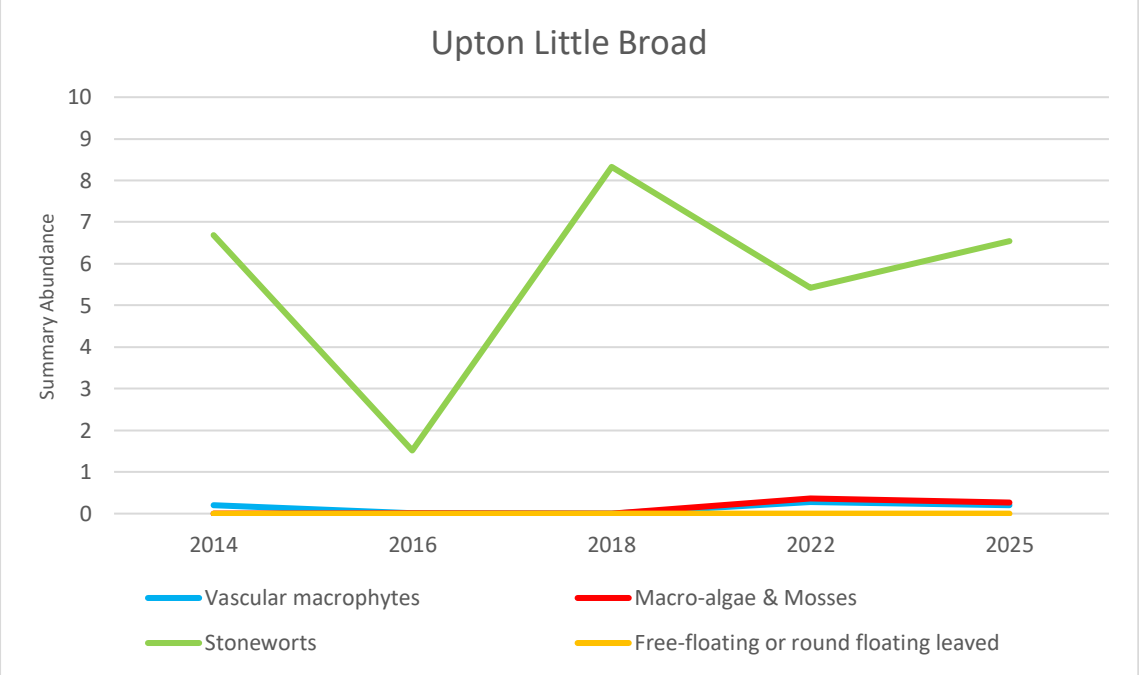
Common Name	Scientific Name	Summary Abundance	Occurrences
Intermediate stonewort	*C. intermedia*	4.147	29
Bristly stonewort	*C. hispida*	2.382	25
Enteromorpha	*Enteromorpha*	0.271	11
Holly-leaved naiad	*Najas marina*	0.179	7
Fennel-leaved pondweed	*P. pectinatus*	0.029	1
Baltic stonewort	*C. baltica*	0.006	2
Filamentous algae	Zygnematales	0.003	1
No plants	No plants	0.000	2
Total number of species recorded		**7**	**Total samples taken: 34**

2025 recorded an increase in stoneworts (5.417 to 6.535) with vascular macrophytes and macro-algae and mosses remaining fairly static. Intermediate stonewort increased (1.194 to 4.147) and in occurrences (20 to 29) whereas bristly stonewort decreased (4.167 to 2.382) and in occurrences (34 to 25). Holly-leaved naiad and Fennel-leaved pondweed were similar to previous years.

Graph 32 &33

Upton Little Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Wroxham Broad

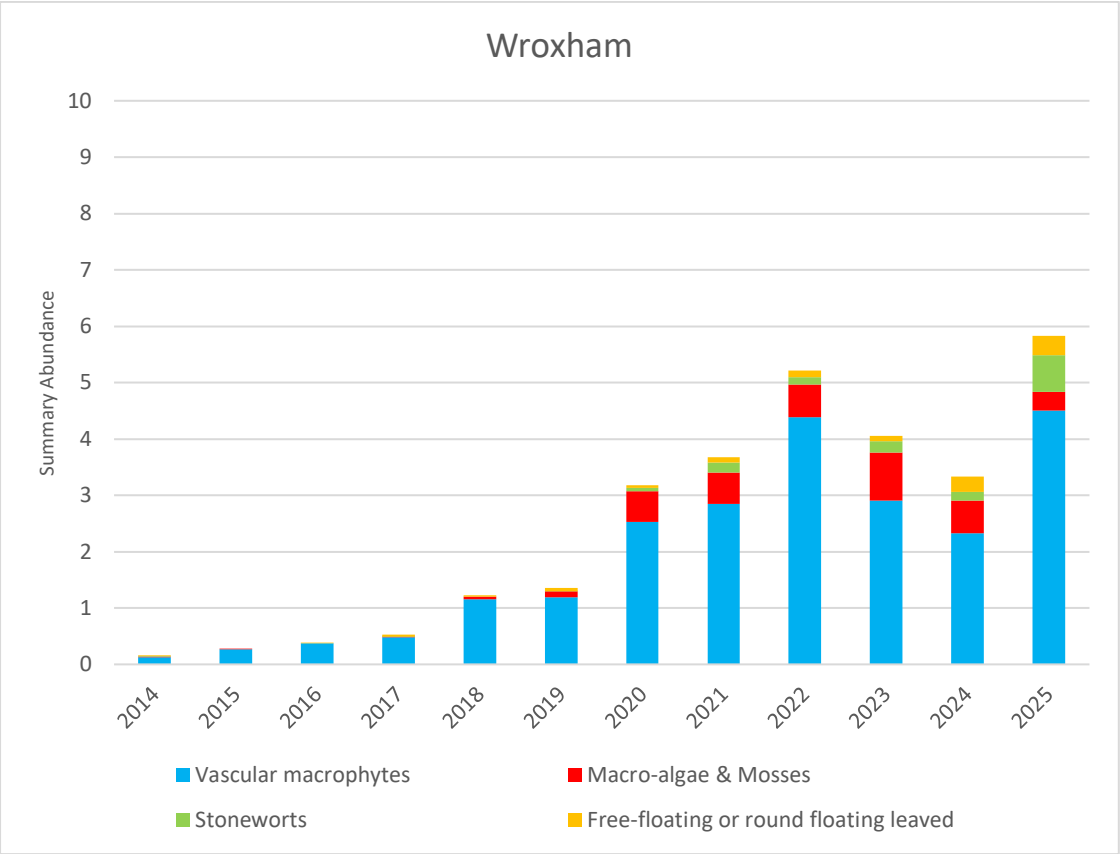
Table 20

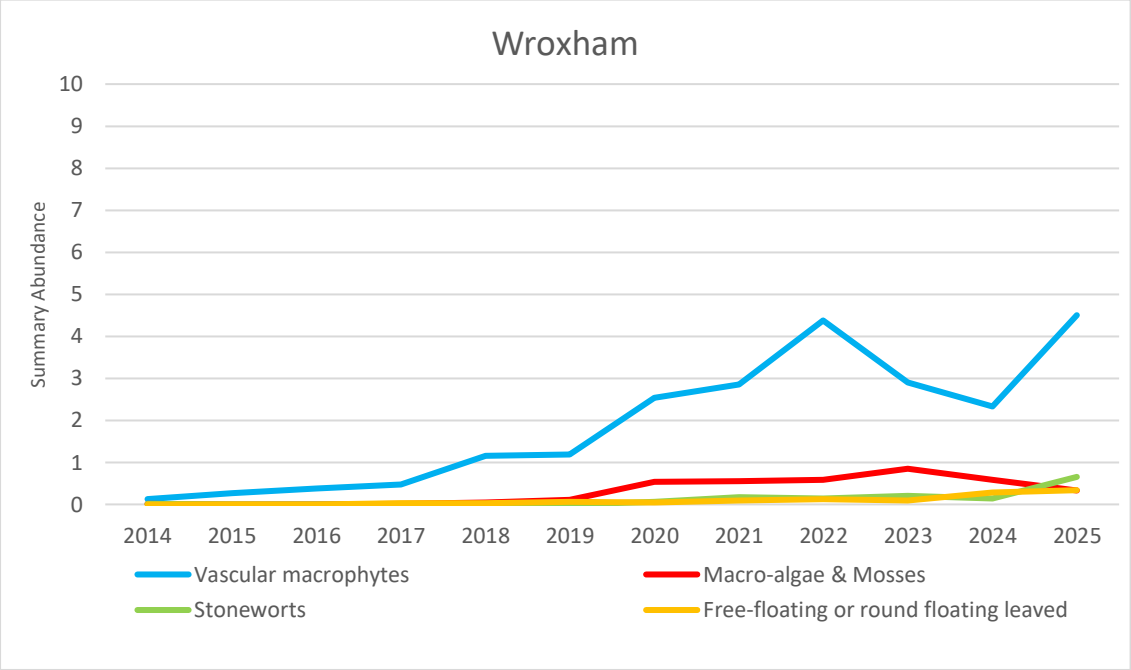
Common Name	Scientific Name	Summary Abundance	Occurrences
Rigid hornwort	*Ceratophyllum demersum*	2.853	59
Nuttall's waterweed	*Elodea nuttallii*	0.957	48
Pointed stonewort	*Nitella mucronata*	0.654	31
Unbranched bur-reed	*Sparganium emersum*	0.382	11
Yellow water lily	*Nuphar lutea*	0.338	10
Filamentous algae	Zygnematales	0.332	27
Fennel-leaved pondweed	*P. pectinatus*	0.118	8
Whorled water milfoil	*Myriophyllum verticillatum*	0.118	7
Spiked water milfoil	*Myriophyllum spicatum*	0.044	3
Canadian waterweed	*Elodea canadensis*	0.029	2
No plants	*No plants*	0.000	5
Total number of species recorded		**10**	**Total samples taken: 68**

An increase in overall abundance was recorded in 2025 from 3.338 to 5.826, with the following species increasing Rigid hornwort (1.397 to 2.853), Nuttall's waterweed (0.221 to 0.957), Pointed stonewort (0.147 to 0.654), Unbranched bur-reed (0.134 to 0.382) and Yellow water lily (0.281 to 0.338). Filamentous algae decreased (0.540 to 0.332). Three mussels were found including Duck, Painters, Zebra and the Asiatic Clam and Fresh water sponge was noted.

Graph 34 & 35

Wroxham Broad summary abundance shown in plant groups (see Appendix 1 for more detail)





Yare Valley

The majority of the broads within the Yare valley are isolated from the main river, with only Bargate, Rockland and Wheatfen having a direct hydrological connection.

2025 Summary

One broad, Rockland, was surveyed in 2025 recording an increase in abundance, similar to 2023 levels

Rockland Broad

Table 21

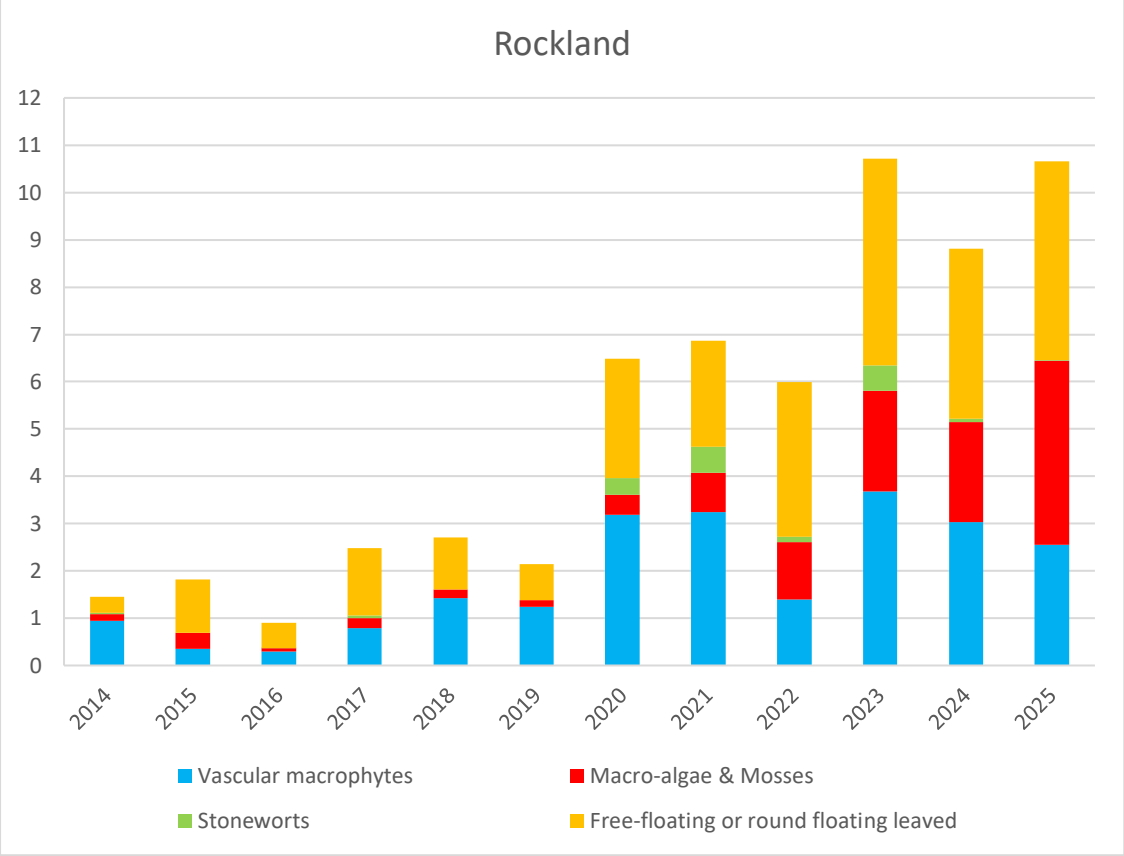
Common Name	Scientific Name	Summary Abundance	Occurrences
Yellow water lily	*Nuphar lutea*	3.919	34
Filamentous algae	Zygnematales	2.615	49
Nuttall's waterweed	*Elodea nuttallii*	1.032	43
Common water moss	*Fontinalis antipyretica*	0.839	21
Enteromorpha	*Enteromorpha*	0.437	26
Starwort species	*Callitriche sp*	0.403	23
Unbranched bur-reed	*Sparganium emersum*	0.339	16
Spiked water milfoil	*Myriophyllum spicatum*	0.195	9
Common duckweed	*Lemna minor*	0.184	15
Arrowhead	*Saggitaria sagittifolia*	0.177	8
Rigid hornwort	*Ceratophyllum demersum*	0.161	10
Fennel-leaved pondweed	*P. pectinatus*	0.145	6
Greater duckweed	*Spirodela polyrhiza*	0.052	5
Fan-leaved water crowfoot	*Ranunculus circinatus*	0.048	3
Water-soldier	*Stratiotes aloides*	0.032	1
Least duckweed	*Lemna minuta*	0.018	2
Ivy-leaved duckweed	*Lemna trisulca*	0.016	1
Frogbit	*Hydrocharis morsus-ranae*	0.016	1
Whorled water milfoil	*Myriophyllum verticillatum*	0.016	1
Pointed stonewort	*Nitella mucronata*	0.016	1

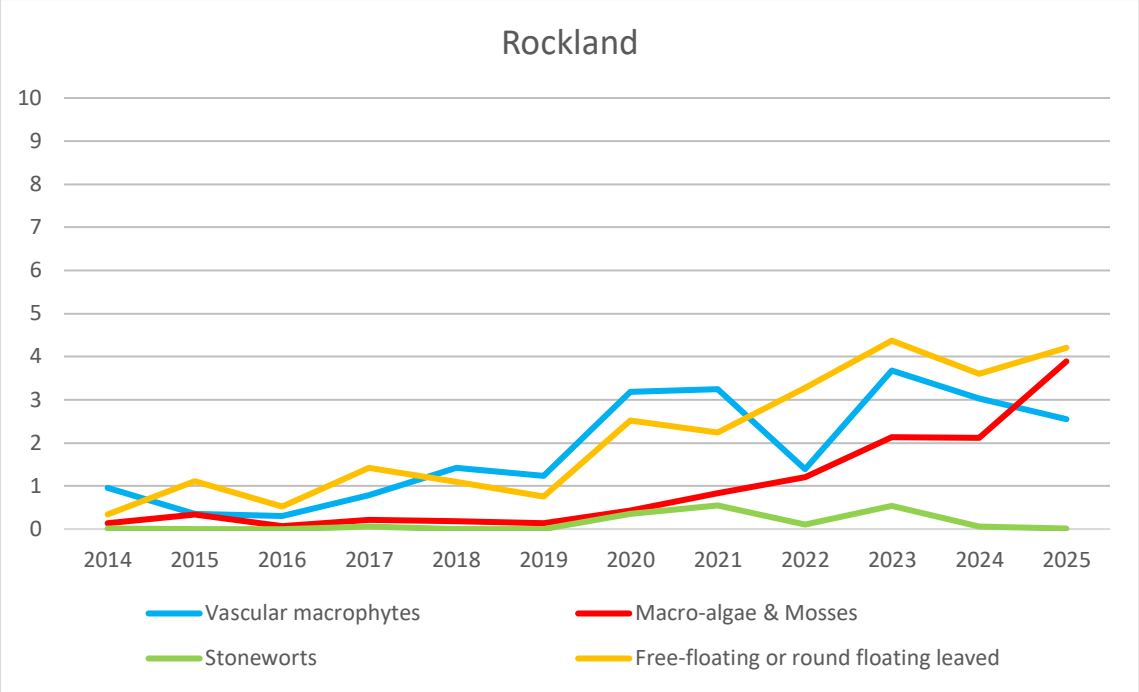
Common Name	Scientific Name	Summary Abundance	Occurrences
Pondweed species	*Potamogeton sp.*	0.002	1
No plants	*No plants*	0.000	1
Total number of species recorded		**22**	**Total samples taken: 62**

Rockland Broad has seen an increase from 8.942 to 10.663 in overall summary abundance. Vascular macrophytes and stoneworts decreased in abundance this year. Yellow water lily (3.229 to 3.919), Filamentous algae (1.406 to 2.615), Common water moss (0.694 to 0.839) , Starwort (0.390 to 0.403) and Enteromorpha (0.018 to 0.437) saw increases. Decreases were seen in Unbranched bur reed (0.566 to 0.339). Painters and duck mussels were found along with Asiatic clam. Fresh water sponge was also noted.

Graph 36 &37

Rockland Broad summary abundance shown in plant groups (see Appendix 1 for more detail)




Rockland
10
9
8
7
6
5
4
3
2
1
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
Vascular macrophytes
Macro-algae & Mosses
Stoneworts
Free-floating or round floating leaved

River Plant 2025 Survey Results

The data collected from each river transect is presented as abundance (the amounts of each species recorded) based on the Braun-Blanquet Scale, as outlined in the river survey methodology. The results tables illustrate the number of points at which each species was recorded to indicate frequency of occurrence. Historical records from past surveys are not presented here, different survey methodologies were used and therefore the results are not directly comparable. However, some comparisons are made between the current years' survey and data collected, using the same methodology, since 2021.

Summary

Vascular plants were the most abundant group of plants observed on most river systems, followed by floating plants, whereas on the Ant there were greater abundances of floating than vascular plants in 2025. More macro-algae and moss species were recorded on the Thurne than on any other river this year. The highest overall plant abundance was recorded on the Thurne, while abundance on the Ant decreased. Plant life was least abundant on the Wensum, with abundance on the Waveney and Bure also relatively low, especially in comparison to 2024 levels for these river systems.

The Wensum had the lowest species richness. The number of species recorded on the Bure and Waveney had increased very slightly in 2025 compared to the 2024 survey. The richest river systems, the Ant and Thurne, both returned fewer species this year.

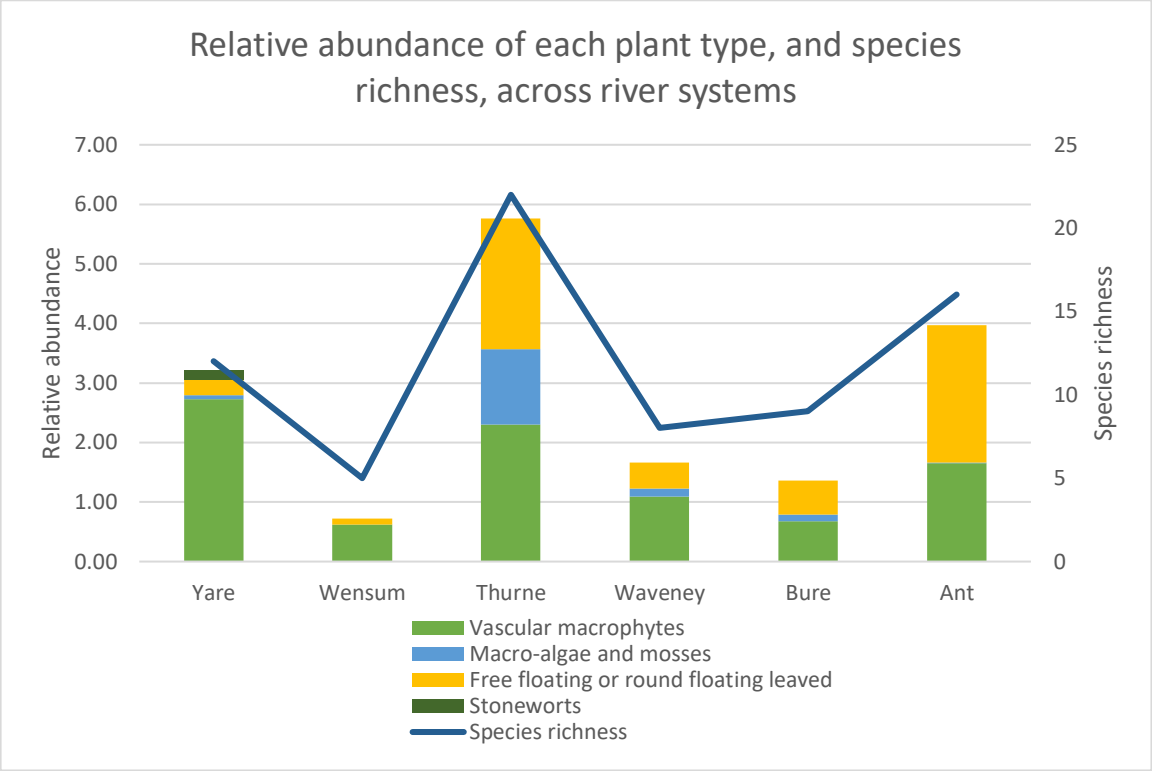
Pointed stonewort *Nitella mucronata* was retrieved at four survey points on the Yare; stoneworts were completely absent from the 2024 survey. The rare and near threatened Water soldier *Statiotes aloides*, which is protected under Section 41 of the NERC[1] Act 2006 was observed in the river margins at one survey point on the Ant. No Section 41 species were officially recorded during this years' survey.

During the Bure survey, an American signal crayfish *Pacifastacus leniusculus* and a juvenile European eel *Anguilla anguilla*, known as a glass eel, were retrieved on the survey rake at different points.

Hemp agrimony and Typha reedmace were retrieved but excluded from the data analysis.

Graph 38

Relative abundance of each plant type, and species richness, across the Broads rivers



Ant

Table 22

Common Name	Scientific Name	Abundance	Occurrence
Frogbit	Hydrocharis morsus-ranae	0.03	1
Yellow water lily	Nuphar lutea	2.28	31
Zygnematales	Filamentous algae	0.00	1
Common water moss	Fontinalis antipyretica	0.01	1
Starwort species	Callitriche sp	0.20	12
Rigid hornwort	Ceratophyllum demersum	0.04	4
Canadian waterweed	Elodea canadensis	0.17	8
Nuttall's waterweed	Elodea nuttallii	0.31	16
Whorled water milfoil	Myriophyllum verticillatum	0.03	2
Fennel-leaved pondweed	P. pectinatus	0.00	1
Fan-leaved water crowfoot	Ranunculus circinatus	0.00	1

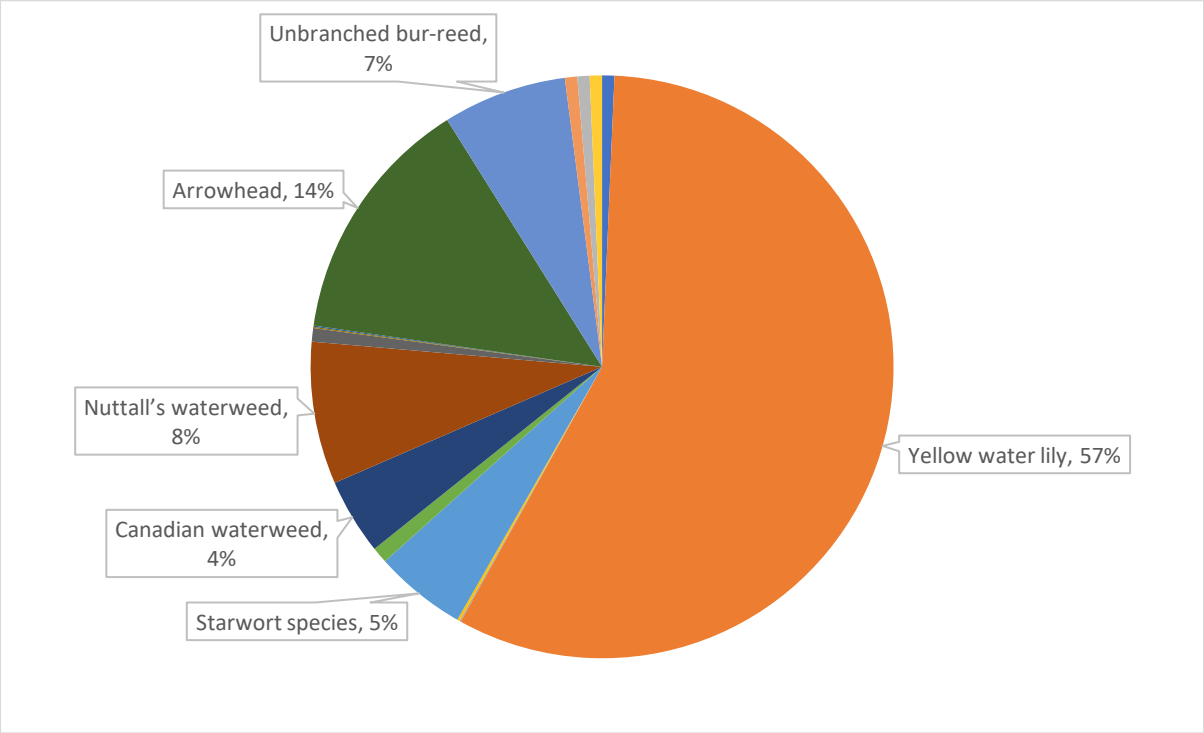
Arrowhead	Saggitaria sagittifolia	0.55	23
Unbranched bur-reed	Sparganium emersum	0.27	11
Water forget-me-not	Myosotis scorioides	0.03	1
Lesser water parsnip	Berula erecta	0.03	1
Water mint	Mentha aquatica	0.03	1
Total number of species recorded: 16		**Total number of samples taken: 37**	

The Ant had the second highest abundance of aquatic plants of all the river systems. Despite a decrease in abundance from 2024, species richness remained relatively high, with 16 species recorded over 37 survey points. Water soldier *Statiotes aloides* was observed in the river margins at one survey point but not retrieved on the rake. The most dominant species was yellow water lily *Nuphar lutea*. Yellow water lily was found in greater abundance on the Ant than the other rivers, although its abundance has been decreasing over the past 3 years. Arrowhead *Saggitaria sagittifolia* was the second most recorded species, followed by Nuttall's waterweed *Elodia nuttallii*. There was a slight decrease in abundance of Unbranched bur-reed *Sparganium emersum* from 2024. Plants were present at every survey point in this year's survey; only 1 survey point had no plants in 2024.

No duckweeds were recorded this year, however Common water moss *Fontinalis antipyretica* appeared in this year's survey and not the previous two. What we suspect to be a phenotypically large variation of fan-leaved water crowfoot *Ranunculus circinatus* was also recorded.

Graph 39

Pie chart showing Ant species diversity



Bure

Table 23

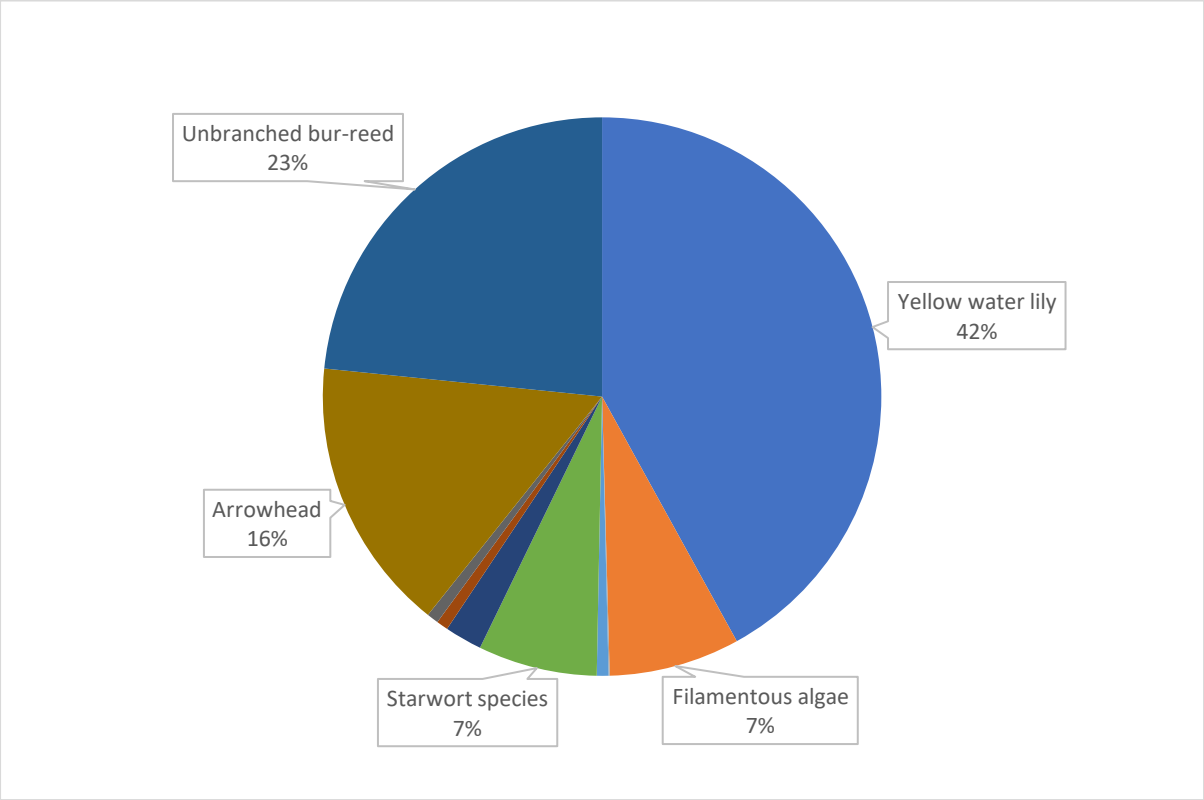
Common Name	Scientific Name	Abundance	Occurrence
Yellow water lily	Nuphar lutea	0.58	21
Filamentous algae	Zygnematales	0.10	22
Common water moss	Fontinalis antipyretica	0.00	1
No plants	No plants	0.00	40
Long-stalked Pondweed	Potamogeton praelongus	0.01	1
Starwort species	Callitriche sp	0.09	12
Nuttall's waterweed	Elodea nuttallii	0.03	5
Fan-leaved water crowfoot	Ranunculus circinatus	0.01	1
River water crowfoot	Ranunculus fluitans	0.01	1
Arrowhead	Saggitaria sagittifolia	0.22	24
Unbranched bur-reed	Sparganium emersum	0.32	24

Total number of species recorded: 10	Total number of samples taken: 108

Yellow water lily *Nuphar lutea* and Unbranched bur-reed *Sparganium emersum* were the most recorded species on the Bure this year, followed by Arrowhead *Saggitaria sagittifolia*. Filamentous algae *Zygnematales* was recorded in 2025 where it was previously absent. The abundance of aquatic plants in the river Bure decreased further from 2024 levels, primarily due to a significant decrease in abundance of vascular macrophytes from 2024. There were no plants recorded at 40 of 108 sample points, representing 37% of the total number of samples taken. There was a modest recovery in species richness, since dredging operations impacted growth in the 2024 season, with 10 species recorded compared with 7 in 2024. Plants retrieved were small and young e.g. Arrowhead bulbs with cotyledons and a few small true leaves. Species are beginning to return to the river; Fan-leaved water crowfoot *Ranunculus circinatus* was recorded this year, there having been a notable absence of water crowfoot species in 2024 compared with previous years. Hemp Agrimony was retrieved on the rake but excluded from the analysis.

Graph 40

Pie chart showing Bure species diversity



Thurne

Table 24

Common Name	Scientific Name	Abundance	Occurrence
Ivy-leaved duckweed	Lemna trisulca	0.04	6
Yellow water lily	Nuphar lutea	2.15	27
Zygnematales	Filamentous algae	0.98	19
Common water moss	Fontinalis antipyretica	0.28	9
No plants	No plants	0.00	8
Alpine water moss	Fontinalis squamosa	0.01	1
Long-stalked Pondweed	Potamogeton praelongus	0.23	17
Starwort species	Callitriche sp	0.41	14
Rigid hornwort	Ceratophyllum demersum	0.14	10
Canadian waterweed	Elodea canadensis	0.22	23
Nuttall's waterweed	Elodea nuttallii	0.11	11
Mare's tail	Hippuris vulgaris	0.24	16

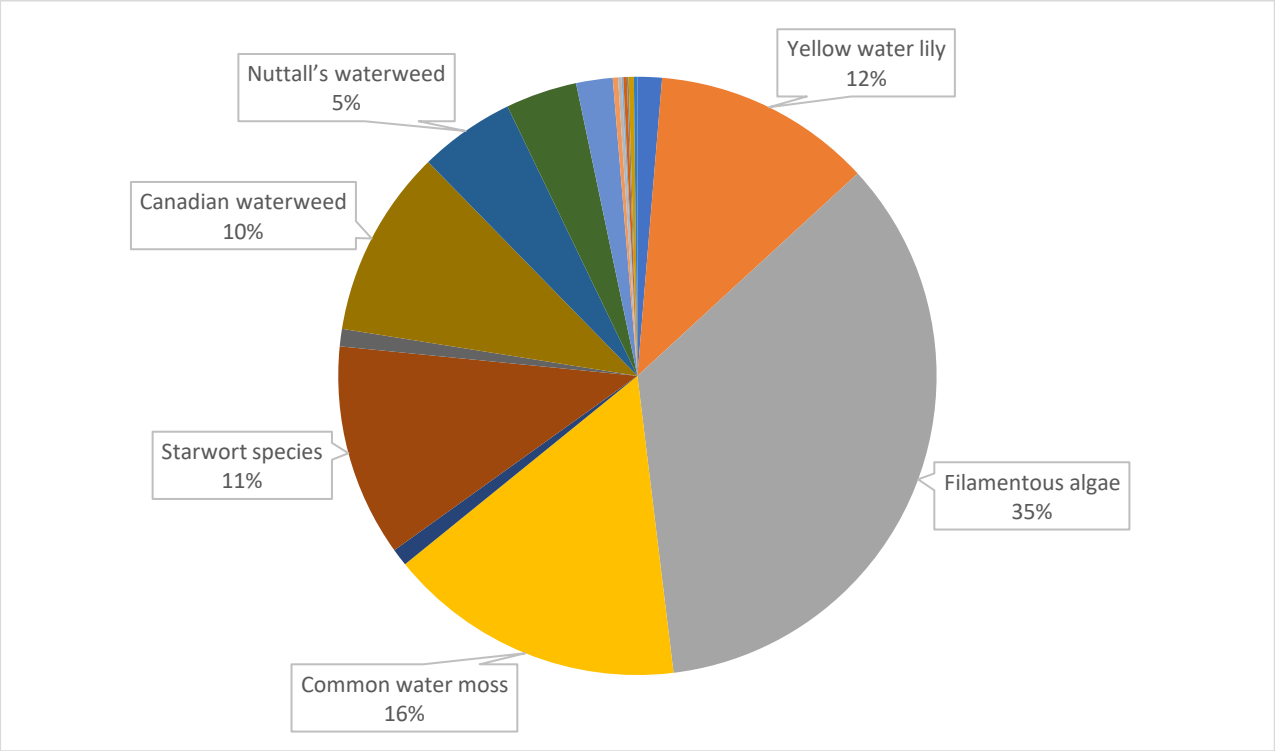
Spiked water milfoil	Myriophyllum spicatum	0.29	16
Whorled water milfoil	Myriophyllum verticillatum	0.00	3
Curled pondweed	P. crispus	0.02	3
Shining pondweed	P. lucens	0.03	1
Fennel-leaved pondweed	P. pectinatus	0.03	3
Perfoliate pondweed	P. perfoliatus	0.23	7
Willow-leaved pondweed	P. x salicifolius	0.05	3
Pondweed species	Potamogeton sp.	0.00	3
Fan-leaved water crowfoot	Ranunculus circinatus	0.03	2
Arrowhead	Saggitaria sagittifolia	0.30	15
Unbranched bur-reed	Sparganium emersum	0.00	2
Total number of species recorded: 22		**Total number of samples taken: 40**	

Yellow water lily, *Nuphar lutea,* was the dominant species on the Thurne system in 2025, despite a high abundance of Filamentous algae, *Zygnementales* recorded in the April (early) survey. Notably, Common water moss *Fontinalis antipyretica* was found in relatively high abundance in April. Significantly higher overall abundance was recorded in the August survey compared with the April survey, predominantly accounted for by increased abundance of yellow water lily *Nuphar lutea*. There were also increases in abundance of *Myriophyllum* and *Callitriche* sp from April to August. In April, eight points were recorded as having no plants; plants were retrieved at every point on the Thurne in the August survey.

Greater species richness was recorded on the Thurne than on any other river system in 2025, with 22 species recorded. Holly-leaved naiad *Najas marina* was notably absent once again from the Thurne this year. This Section 41 species had been found in the Thurne since 2021, reaching peak abundance in 2022 when it was recorded at 3 points during both early and late surveys. In 2023 it was recorded at only one point in each survey, at a lower relative abundance.

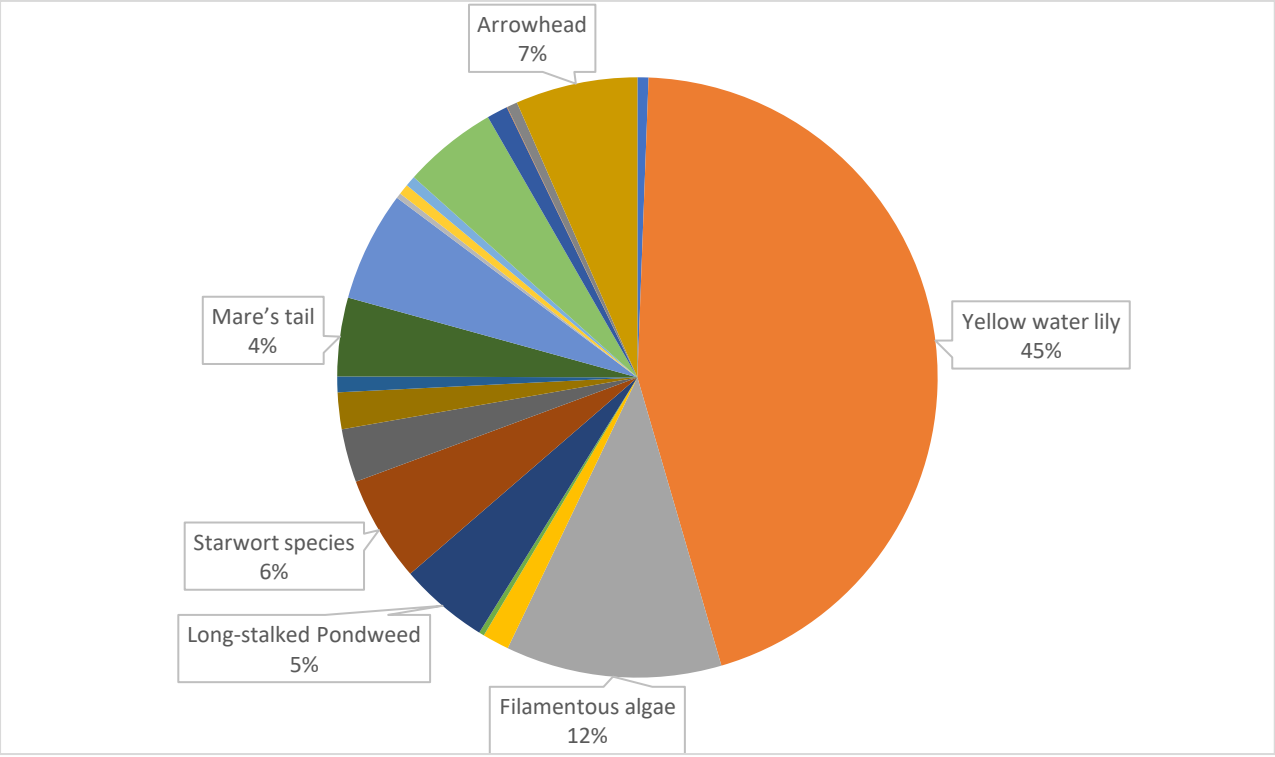
Graph 41

Pie chart showing April survey results from the Thurne



Graph 42

Pie chart showing August survey results from the Thurne



Waveney

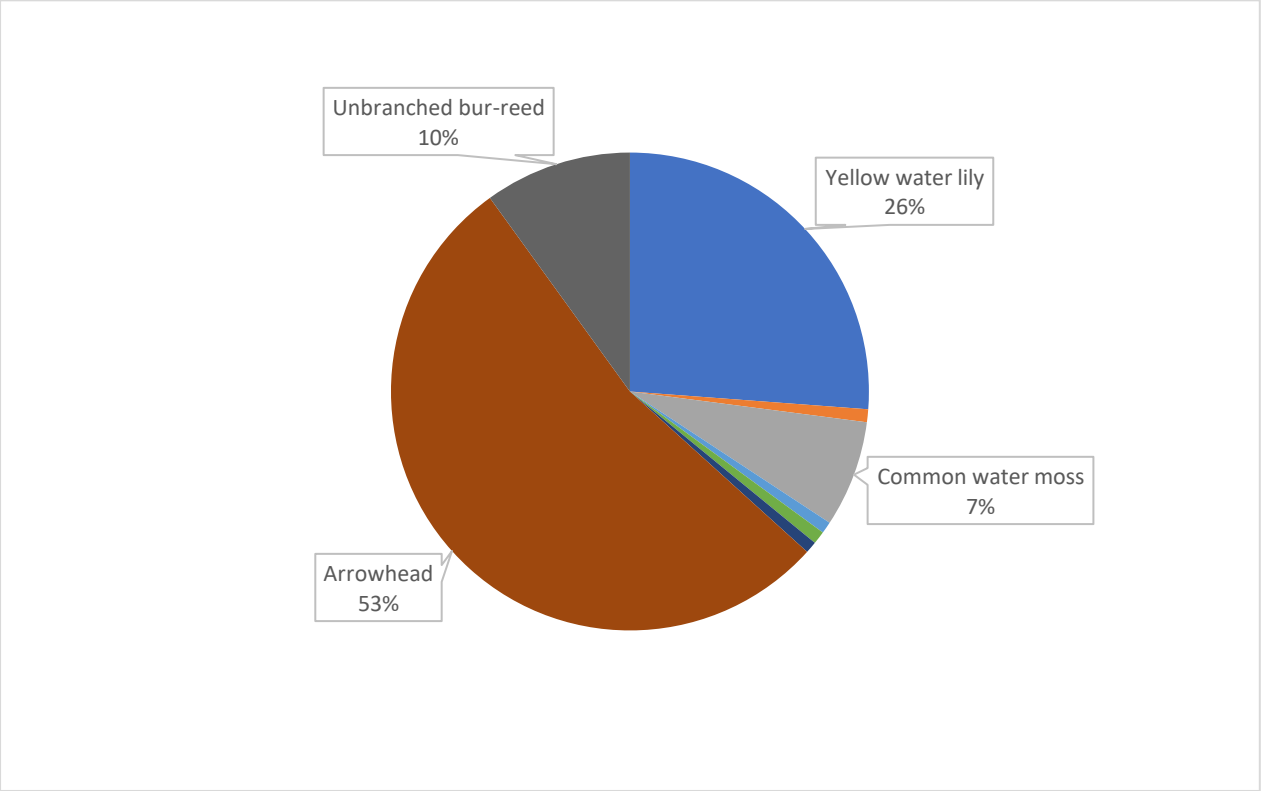
Table 25

Common Name	Scientific Name	Relative Abundance	Occurrence
Yellow water lily	Nuphar lutea	0.44	18
Filamentous algae	Zygnamentales	0.01	2
Common water moss	Fontinalis antipyretica	0.12	7
No plants	No plants	0.00	17
Nuttall's waterweed	Elodea nuttallii	0.01	1
Lesser water parsnip	Berula erecta	0.01	2
River water dropwort	Oenanthe fluviatilis	0.01	1
Arrowhead	Saggitaria sagittifolia	0.89	52
Unbranched bur-reed	Sparganium emersum	0.17	18
Total number of species recorded: 8		**Total number of samples taken: 76**	

Arrowhead *Saggitaria sagittifolia* occurred frequently on this year's survey, at 52 points of a total 76 surveyed (68%); the abundance of arrowhead is comparable to previous years. The Waveney was dredged in 2023, and the age of the arrowhead plants was noticeably greater than those retrieved from the Bure, which had been dredged within the 12 months preceding the survey. The Arrowhead's leaves resembled those of well-established adult plants with distinctive crinkling and raised mid-rib. Species richness decreased from 2023 to 2024 and remained low, with not much change in species composition in 2025. Rigid hornwort *Ceratophyllum demersum* was absent from this year's survey, as were the stoneworts and starworts recorded in 2023. Plant abundance also remained low, and there were 17 sample points at which no plants were retrieved this year.

Graph 43

Pie chart showing Waveney species diversity



Wensum

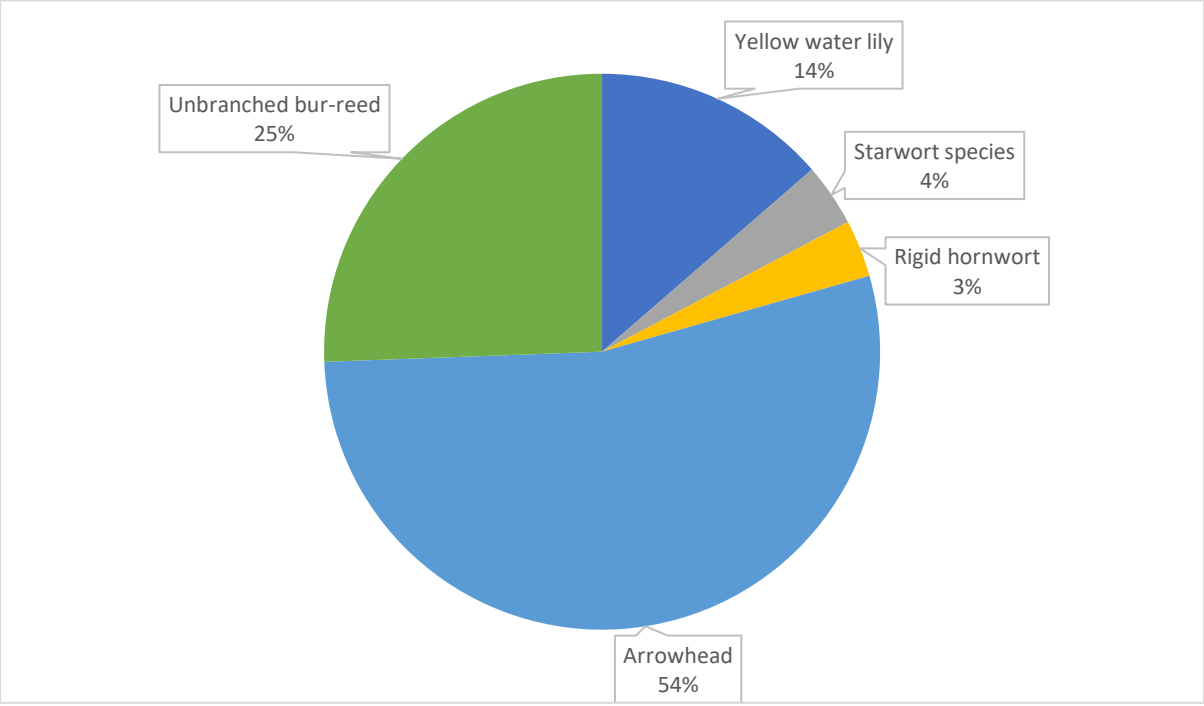
Table 26

Common Name	Scientific Name	Abundance	Occurrence
Yellow water lily	Nuphar lutea	0.10	4
No plants	No plants	0.00	17
Starwort species	Callitriche sp	0.03	2
Rigid hornwort	Ceratophyllum demersum	0.02	1
Arrowhead	Saggitaria sagittifolia	0.39	17
Unbranched bur-reed	Sparganium emersum	0.18	14
Total number of species recorded: 5		**Total number of samples taken: 42**	

Plant life on the Wensum was least abundant of that on all river systems in 2025. The abundance of yellow water lily *Nuphar lutea* on the Wensum decreased significantly from 2024 and was overtaken by Arrowhead *Saggitaria sagittifolia* as the most abundant species in 2025. The upper Wensum had 17 points with no plants, which represents 40% of the points surveyed. Plant abundance decreased dramatically from 2024 and species richness was notably low in comparison to the Yare this year, with five species recorded compared to the Yare's twelve. The *Potamogeton* spp, Spiked water milfoil *Myriophyllum spicatum* and Common water moss *Fontinalis antipyretica* which appeared on the 2024 survey were absent this year.

Graph 44

Pie chart showing Wensum species diversity



Yare

Table 27

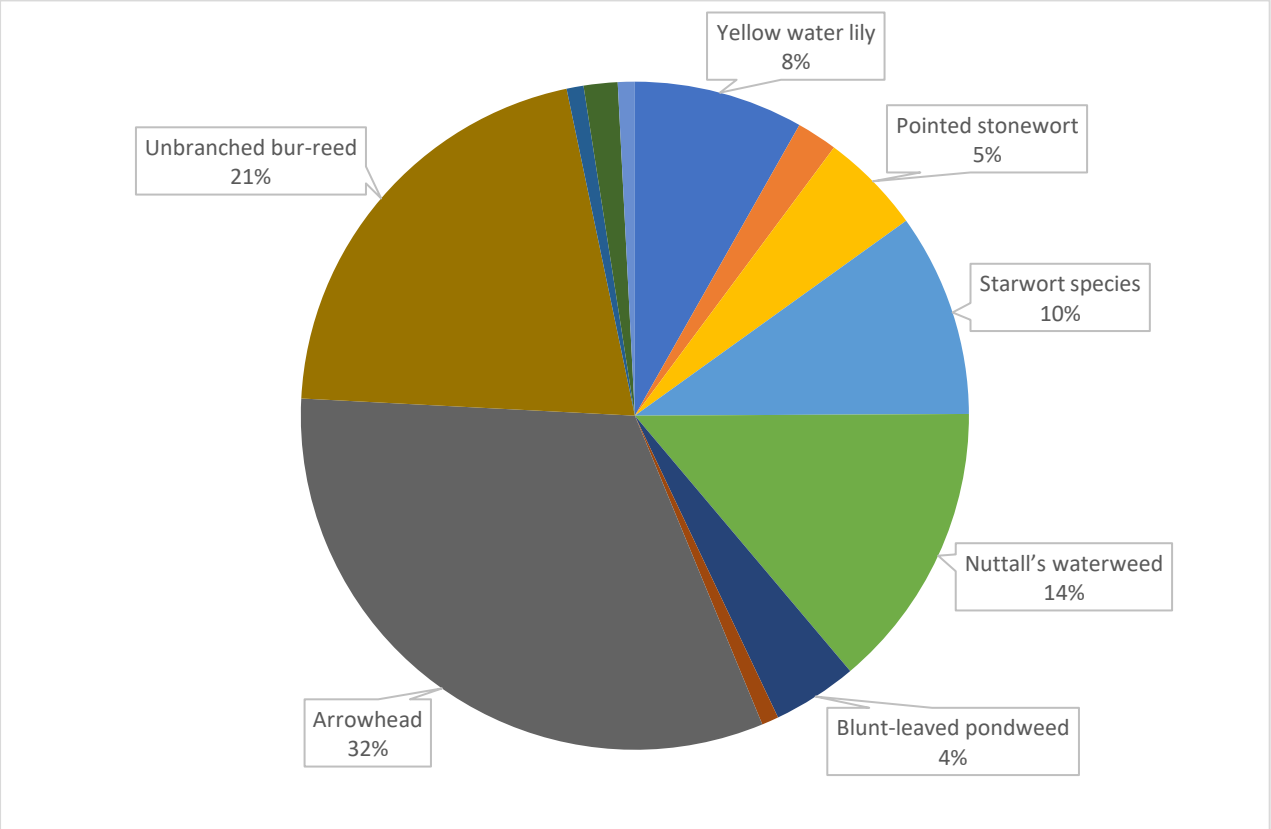
Common name	Scientific name	Abundance	Occurrence
Yellow water lily	Nuphar lutea	0.26	6
Zygnematales	Filamentous algae	0.06	6
No plants	No plants	0.00	1
Pointed stonewort	Nitella mucronata	0.16	6
Starwort species	Callitriche sp	0.32	9
Nuttall's waterweed	Elodea nuttallii	0.45	16
Blunt-leaved pondweed	P. obtusifolius	0.13	5
Fennel-leaved pondweed	P. pectinatus	0.03	1
Arrowhead	Saggitaria sagittifolia	1.03	33
Unbranched bur-reed	Sparganium emersum	0.67	29
Branched bur-reed	Sparganium erectum	0.03	1
Fool's watercress	Helosciadium nodiflorum	0.05	1

River water dropwort	Oenanthe fluviatilis	0.03	1
Total number of species recorded: 12		**Total number of samples taken: 38**	

Unbranched bur-reed *Sparganium emersum* and Arrowhead, *Saggitaria sagittifolia* were the dominant species on the river Yare in 2025. There was good species richness in the reach surveyed, with a total of 12 species recorded. Blunt-leaved pondweed *Potamogeton obtusifolius* and Branched bur-reed *Sparganium emersum* were recorded on this year's survey, whereas not on the previous two. Pointed stonewort *Nitella mucronata* was recorded at 6 points on the Yare, the only occurrence of a Section 41 species recorded in 2025. The abundance of vascular macrophytes had declined slightly from 2024, however overall abundance remained relatively high, and the third highest of all river systems after the Thurne and Ant. It was possible this year to survey all 38 points, only one of which had no plants recorded.

Graph 45

Pie chart showing Yare species diversity



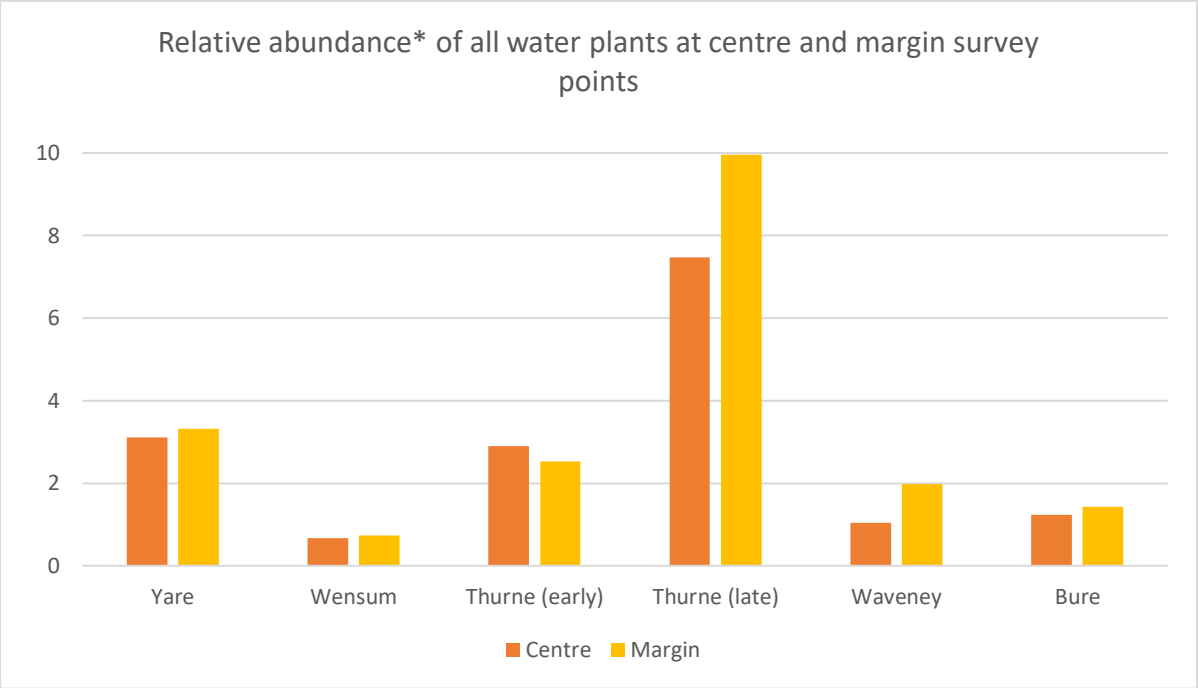
Variation between centre and margin points

Whilst routine maintenance of navigation channels is one of the Broads Authority's statutory obligations, it is important to leave an unmanaged margin of at least 3 meters from the riverbank not only to consolidate the bank structure and buffer surrounding habitat but also to maintain a connection through the riverine landscape. A diversity of riparian vegetation is fundamental to supporting populations of invertebrates, mammals, birds, and fish, by oxygenating the water and providing shelter and food at different life cycle stages.

It was hypothesised that plants would have a greater abundance at the river channel margins than in the centre. In 2025 this was true for all river systems. The greatest difference was seen on the Thurne between centre and margin points during the August survey.

Graph 46

Relative abundance of plants between centre and margin survey points



**Abundance calculated relative to the number of survey points on each river.*

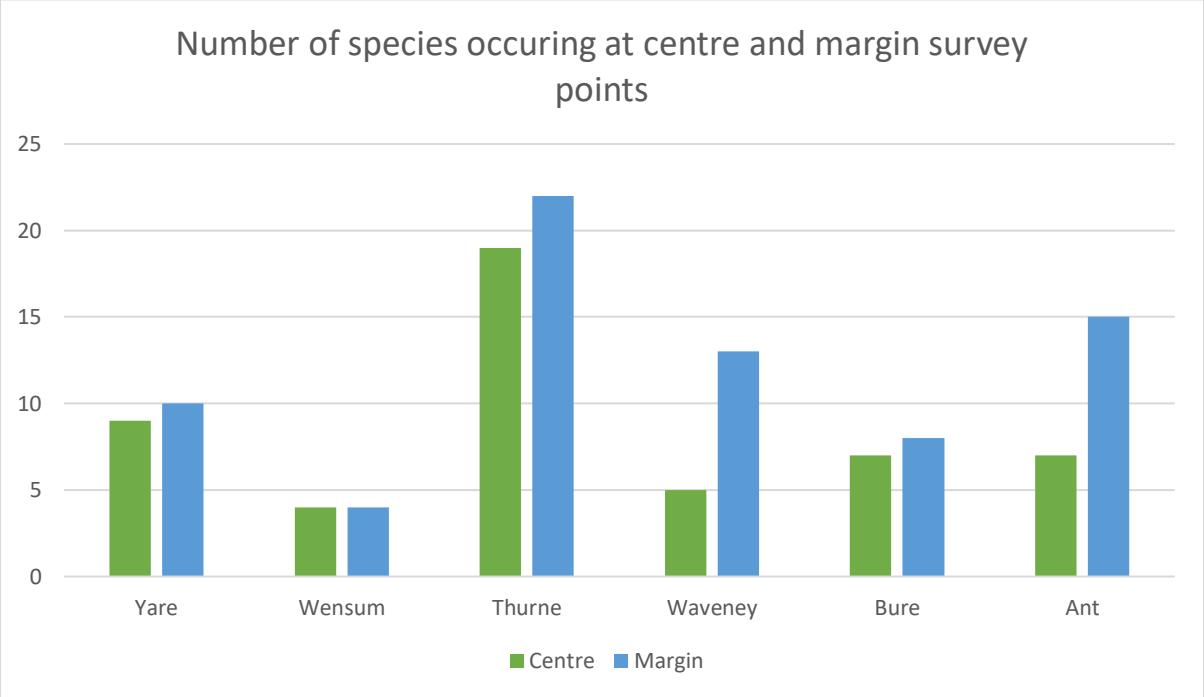
Across all river systems species richness was higher at the margins than in the centre of the river channel. Once again, the Thurne had the greatest species richness overall, and a small difference in number of species observed between centre and margin. The

greatest difference was observed on the Ant (7 species in the centre, compared with 15 in the margins). There was more than double the number of species in the margins of the Waveney than in the centre.

Survey point position in the river made the least difference to species richness on the river Wensum, with four species recorded for both margin and centre survey points. Three species remained constant between points, however Starwort *Callitriche* sp was only retrieved in the centre, just as Rigid hornwort *Ceratophyllum demersum* was only found at the margins.

Graph 47

Species count comparison between centre and margin survey points



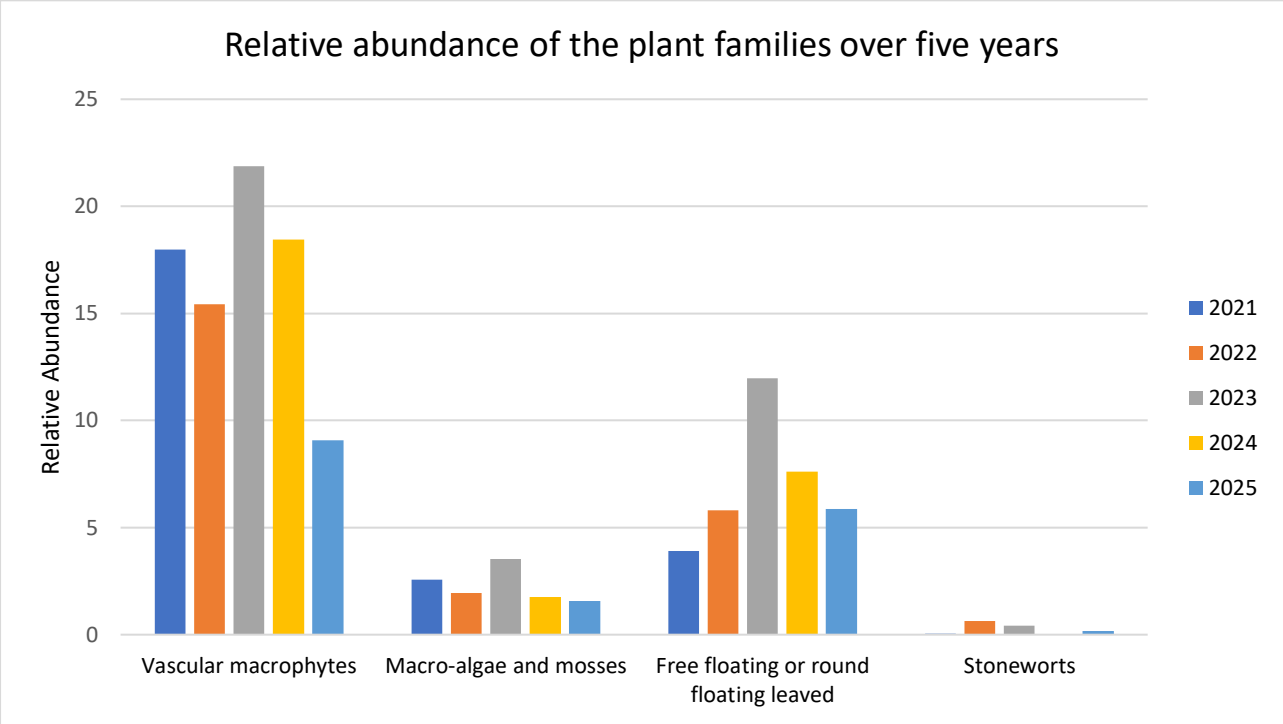
Annual comparison across all surveyed stretches

There was a marked decrease in abundance of vascular plants recorded in 2025, a five-year low for this plant type. This continues a downward trend observed since 2023, when abundance of vascular plants was at its highest for five years. This trend is also seen in the abundance of free-floating or round-floating plants. The abundance of macro-algae and mosses also decreased this year. Unlike in 2024 where no stonewort species were observed, Pointed stonewort *Nitella mucronata* was retrieved at six survey

points on the Yare in this year's survey, making up 5% of the total plant abundance observed there.

Graph 48

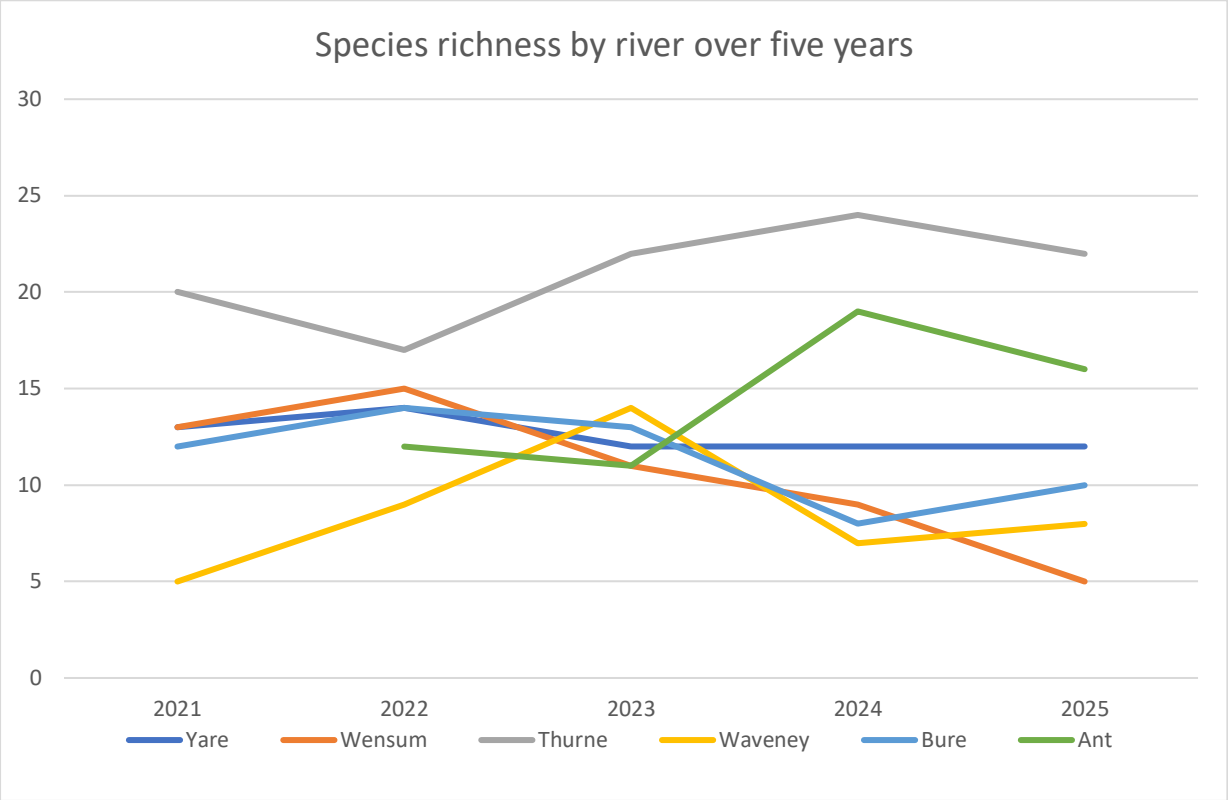
Relative abundance across plant families 2021-2025



The downward trend in overall plant abundance continued for its third year in 2025 for all plant groups except the stoneworts, which were represented by the retrieval of Pointed stonewort *Nitella mucronate* at six survey points on the river Yare. The species richness of the reliably more biodiverse rivers, the Thurne and Ant, also saw a downturn this year. The Bure and Waveney saw a small increase in number of species recorded in 2025 from 2024.

Graph 49

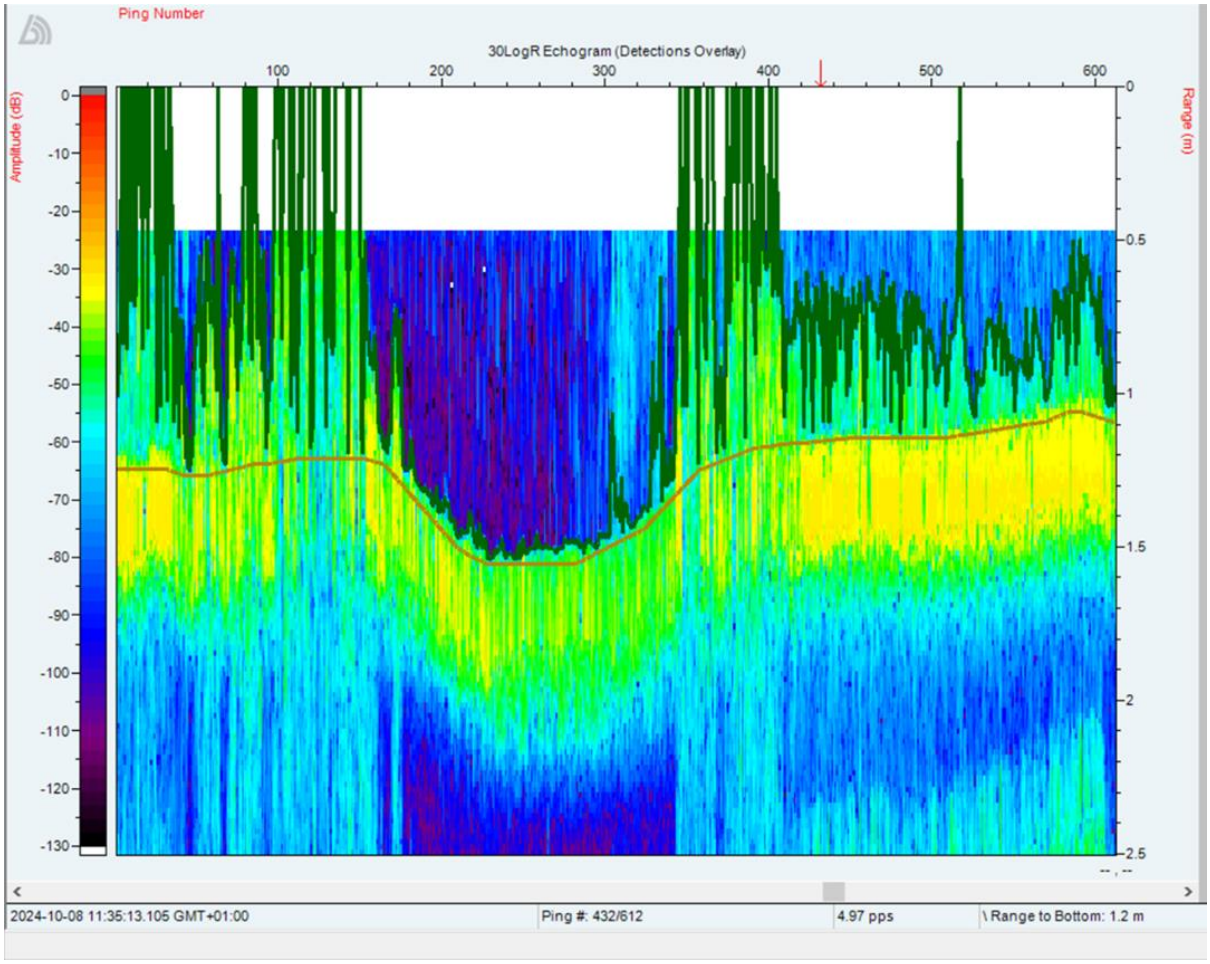
Number of species recorded in each river 2021-2025



***There was no data collected on the Ant in 2021.*

Figure 1

Hydroacoustic echogram of Hickling Broad



Background Information

Hickling Broad

Hickling Broad (Figure 2) is the largest body of water within the Norfolk & Suffolk Broads, comprising 128 hectares (ha) of open water. The broad has an average depth of between 0.68m to 1.86m and the bed is mostly comprised of soft mud with a layer of fluidised sediment on top. Hickling Broad contains species and habitats of high conservation importance and is also a key navigation waterbody within the Broads executive area.

Figure 2
Aerial image of Hickling Broad from 2025

As the navigation authority, the Broads Authority (BA hereafter) is obliged to maintain navigable access within the Broads Executive Area. Water plants, especially during the summer when growth can be prolific, can reduce accessibility for boats. For Hickling Broad, waterways specifications are assessed with consideration to the presence of protected water plant communities. Given the good water plant growth in Hickling Broad and the importance of the broad to navigation and recreation, the main channel was dredged in February 2021; cutting of submerged water plants is undertaken in the summer (assent from Natural England is currently in place) within the marked channel to enable boat access to continue.

Hydroacoustic Survey

Hickling Broad is monitored by the BA to assess the condition and status of the water plant community and provide useful information to inform management decisions. Two complimentary survey techniques are conducted.

1. Hydroacoustic surveys, which have been undertaken annually at Hickling since 2012, provide a measure of the height, cover and volume of water plants across the broad (see Table 1, Appendix 1 for historical information.)

2. Standard water plant surveys identify the species present at 39 sampling points and provide a score of their abundance. The purpose of this report is to present the findings of the hydroacoustic surveys of Hickling Broad.

Survey equipment

Hydroacoustic survey equipment, utilising sonar technology, is commonly used for detection, assessment, and monitoring of underwater physical and biological objects. Boat-mounted hydro-acoustic equipment can be utilised to detect the depth of a water body (bathymetry), as well as the presence or absence, distribution and size of underwater plants.

Such survey equipment measures the range to an object and its relative size by producing a pulse of sound and measuring the time it takes for an echo to return from the object and the amplitude of the returned echo. The range is calculated as a function of the speed of sound and the time it takes for the echo to return.

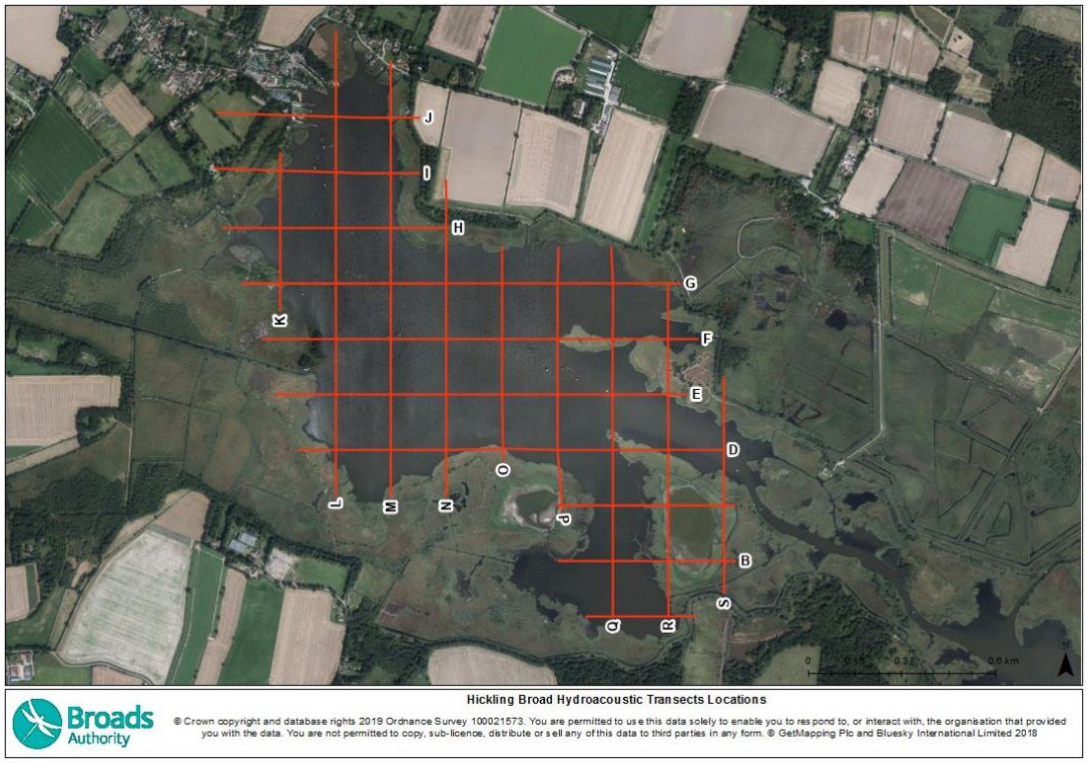
The surveys at Hickling are completed with updated hardware (BioSonics DT-X scientific echosounder) and software which was first used in the August 2021 survey. The older equipment (DTX biosonics) was replaced as the software was no longer being supported.

Survey design & timings

Since 2018, 19 transects across the Broad are surveyed (see Figure 2.) The length of the programmed transects are between 150 to 1020m and the survey consists of ten transects on an east – west axis and nine on a north – south axis. These parallel transects are 177 m apart and the location where transects intersect corresponds to the sample points for the annual water plant survey.

Three surveys were conducted by trained BA staff on 15 May, 20 August and 08 October 2025.

Figure 3
Location of the 19 hydroacoustic survey transects (A-S) covering Hickling Broad



Survey methodology

The hydroacoustic surveys are conducted by navigating a survey boat along the transects (see Figure 3), maintaining a constant speed of approximately 5 miles per hour (mph). The equipment used in this survey includes a BioSonics DT-X, single beam (10°), 420 KHz transducer, with an on-board control unit and operating laptop. All data recorded is geo-referenced through connection to an internal GPS receiver. This allows subsequent quantitative analysis of the data using Visual Aquatic post-processing software, developed specifically with a vegetation analysis component (see below).

Table 1 presents the total length of transects surveyed in each of the surveys conducted in 2025.

Table 1
Sampling details

Survey date	Number of transects	Distance surveyed (m)
15 May 2025	19	11,677
20 August 2025	19	11,424
8 October 2025	19	11,250*

*dense aquatic vegetation around the fringes of the Broad restricted boat access to the marginal areas of Transect F,G,H,S,R, M and L in October.

Data analysis & results

Using the Visual Aquatic software, the sediment surface of each transect is identified, as well as the less intense return derived from the upper surface of the water plants. Due to the fluidity of the bottom sediment, an analyst is needed to manually edit the automatically plotted Broad bed; this inevitably results in some subjectivity, and changes in analyst may result in slight variations in interpretation of the sonogram (see Figure 4.) The sonar produces 5 pings per second and the transects were analysed every 10 pings. The programme produces a report on those 10 pings to get an average on depth, plant height and percentage cover.

The results derived from the processing of the hydroacoustic data are then used to calculate:

- Maximum and mean plant height (m)
- Mean percentage of lake bed covered by water plants (%PAI)
- Mean percentage volume of the water column inhabited by water plants (%PVI)

Overall means are calculated for each survey for the entire broad and the individual transects (A to S). Water depth on the date of the survey is recorded and variability between surveys should be considered when interpreting results. Water depths are noted with the result tables and accompanying maps.

The results of the three surveys of Hickling Broad undertaken in 2025 are summarized in Table 2.

Table 2

Results of the hydroacoustic surveys of Hickling Broad in 2025

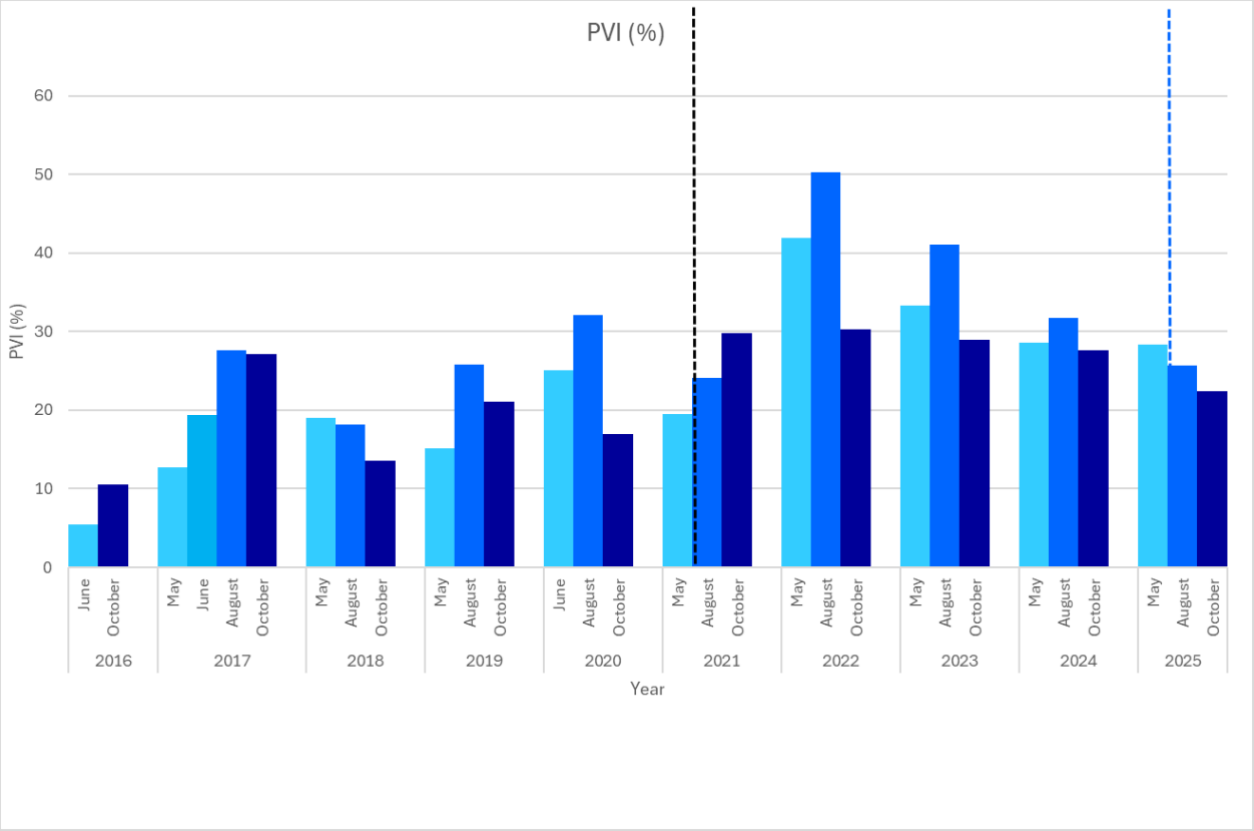
Metric	May 2025	August 2025	October 2025
Mean water level (metres Above Ordnance Datum)	0.37m	0.44m	0.56m*
Maximum water depth (m)	1.81m	1.91m	2.10m
Mean water depth (m)	1.27 m	1.32m	1.41m
Maximum plant height (m)	1.11m	1.34m	1.29m

Metric	May 2025	August 2025	October 2025
Mean plant height (m)	0.39m	0.38m	0.35m
PAI (%)	79.04	78.30	76.71
PVI (%)	28.31	25.66	22.39

*Shoothill GaugeMap data [Latest updates on Storm Franklin | GaugeMap] was unavailable between 7 and 12 October 2025. Data from 6 October is therefore shown.

Plant volume

Figure 4
Mean PVI (plants in water column as %) from all transects (May/June, Aug & Oct), 2016 – 2025



*(NB the **black** dashed vertical line shows change of sonar equipment in August 2021 – comparison of results before and after this date may be unreliable. The **blue** dashed vertical line shows change of sonogram analyst – potential minor variation before/after due to subjectivity.)*

As Figure 4 illustrates, PVI often peaks in August and then drops dramatically in October. By August, plant density will be high following the main growing period, but water levels often low due to summer evaporation; this means the proportion of plants in the water column will be relatively high. By October, plants are starting to die-back and with increasing autumn water levels, the percentage of plants occupying the water column diminishes.

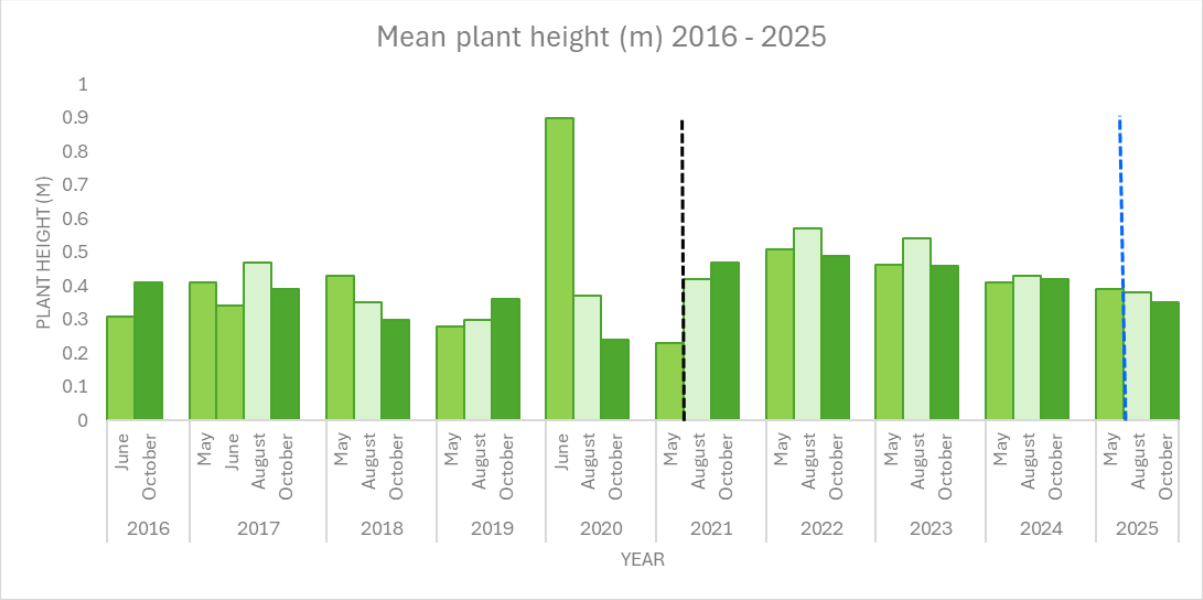
2025 displays a variation to this pattern. PVI steadily drops from 28.31% in May to 22.39% in October, without an August peak. Mean plant height (Figure 5) and mean % plant cover (Figure 7) follow the same pattern this year, ie a gradual reduction throughout the growing season. Decreasing plant height combined with increasing water levels would account for a decrease in PVI% over the same period. Minor residual effects may be attributed to a change in sonogram analyst in August 2025, but not at a Broad-wide scale. 2018 demonstrates a similar pattern with diminishing PVI% throughout the year mirrored by decreasing PVI%.

More notable is the steady decrease in PVI% between 2022 and 2025, most pronounced in August where it falls from 50% in August 2022 to 26% in 2025.

Plant heights

Figure 5

Mean plant height (m) from all transects (May, Aug & Oct), 2016 – 2025



*(NB the **black** dashed vertical line shows change of sonar equipment in August 2021 – comparison of results before and after this date may be unreliable. The **blue** dashed vertical line shows change of analyst.)*

Figure 5 shows that mean plant heights have decreased slightly each season since 2022, with August peaks dropping from 57cm in 2022 to 38cm this year. Seasonal variation is also limited, with mean plant heights ranging from 39cm in May to 35cm in October.

It should be noted that mean plant height is derived from the full data set, which includes readings from the navigation channel, where plant heights are often minimal.

Figure 6
Plant heights (m) across the transects in 2025

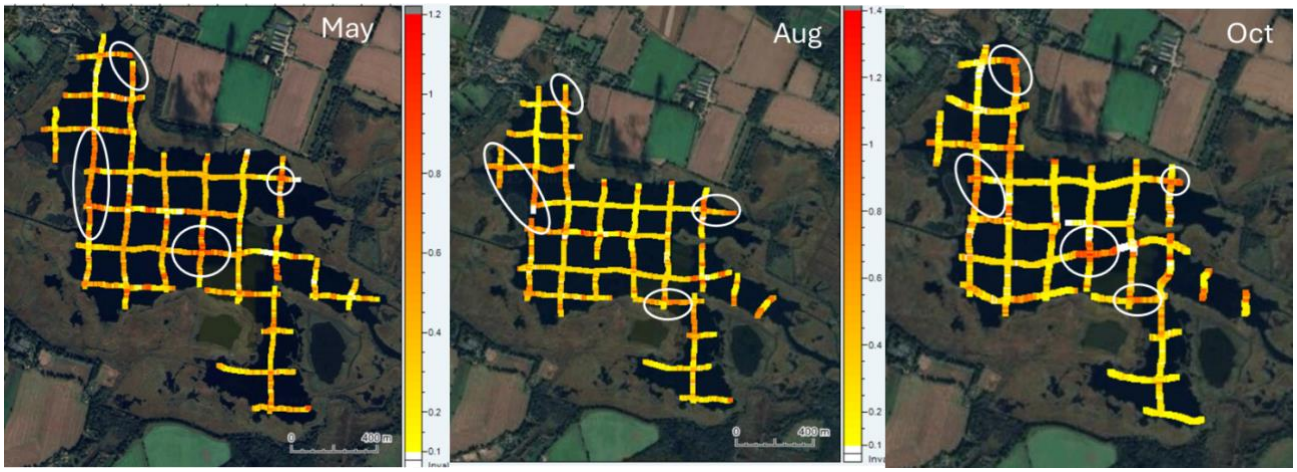


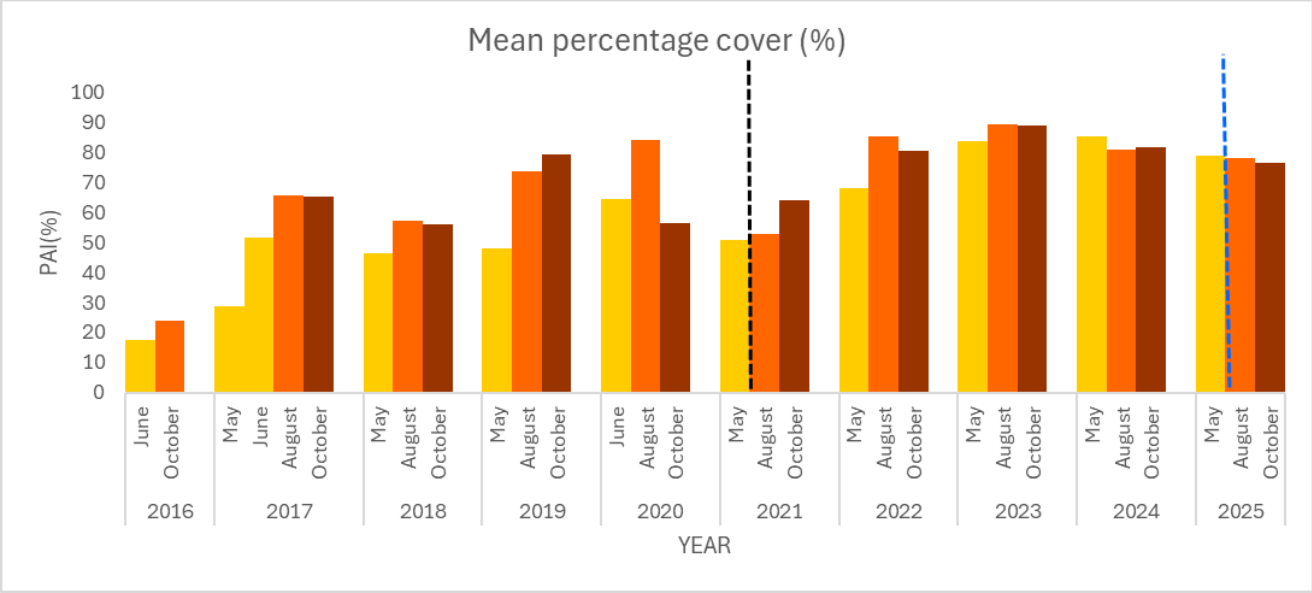
Figure 6 illustrates plant heights across the Broad during each survey. The darker the colour, the taller the plant. Deep red indicates plants taller than 1m tall. The marked channel appears as white or pale yellow, with minimal plant growth. The white ovals on Figure 6 outline the areas of the Broad consistently showing the greatest plant heights, peaking in August at above 1m. Some of these areas are the most sheltered or undisturbed parts of the broad. Others are where ridges of dredgings alongside the main channel encourage strong growth; these “lines” of tall, dense aquatic vegetation can be clearly seen as dark lines in Figure 6.

Figure 6
Colour-enhanced aerial photo of Hickling Broad, 2025, showing the main navigation channels (pale blue dashed lines)

Plant cover

Figure 7

Mean PAI (plant cover across bed as %) from all transects (May, Aug & Oct), 2016 – 2025



*(NB the **black** dashed vertical line shows change of sonar equipment in August 2021 – comparison of results before and after this date may be unreliable. The **blue** dashed vertical line shows change of analyst.)*

Figure 7 shows that the mean area of the Broad bed covered with plants ranged from 77% to 79% this year, with the peak in May. These percentages are lower than peak coverage of 89% in August 2023.

Figure 8
Plant cover as % of the Broad bed in 2025

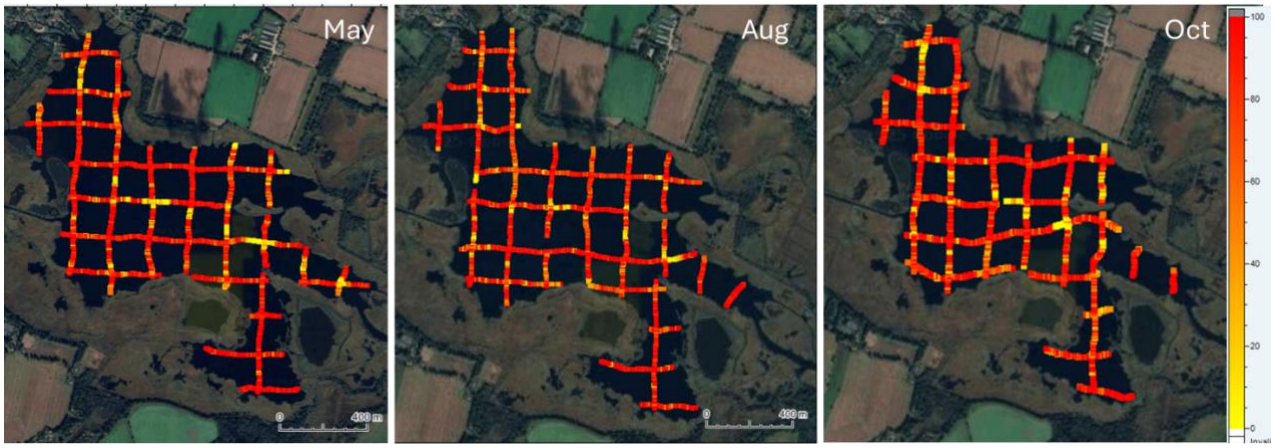


Figure 8 shows percentage plant cover across the Broad during the three survey periods. The yellow lines show areas of the Broad with less than 10% plant cover and represent the marked channel (9% of surveyed area.)

Based on the August 2025 results, 36% of the transect *points* had 100% cover, 56% more than 80% cover and 68% more than 70% cover. This is a slight reduction from previous years.

Water depths

Figure 9
Water depths (m) 2025

The maps in Figure 9 show the **water depths** of Hickling along the transects during the survey. The marked channel (running SE to NW across the Broad) and the channel to Catfield Dyke can be identified from the darkest blue points.

Maximum water depths of 1.81m – 2.10m were maintained in these channels across all three surveys. Mean water depths across the main Broad rise throughout the year, from 1.27m in May to 1.41m in October. Outside of the main channels, the Broad shows little variation in water depth until the shallower fringes are met, particularly to the south.

Key findings & Recommendations

- Mean PVI and plant height are lower in each season this year compared to the previous three years, with a decline in both throughout the year.
- **Increasing** water levels, coupled with **decreasing** mean plant heights, may account for the falling PVI throughout the year.
- Plant heights peaked in August, with a maximum height of 1.34m recorded.
- 56% of survey points in August had more than 80% vegetation cover; this is a much lower percentage than last year when 76% of August survey points had more than 80% cover. The range of mean %cover was also more limited compared to previous years, only varying between 76 - 79% cover, without a noticeable August peak.
- The southern areas of the broad, particularly around Chara Bay, and the sheltered bays on the eastern and northern fringes display some of the highest plant growth and % coverage. A dense line of vegetation was also notable alongside the dredged channel in places.
- The dredged channels show the greatest water depths of 1.81 – 2.10m with only 0 – 10% plant coverage on the bed.

Appendix 1: details of hydroacoustic surveys from 2013 – current year

Hydroacoustic surveys have been conducted annually at Hickling Broad since 2012. In 2016, the survey design was updated to incorporate the water plant survey points with the frequency of surveys also increased. In 2017, an additional 18 transects, running parallel to the main transects were surveyed in June, August and October, to increase the coverage of the western section of the broad. The increased survey effort was in response to the expansion of water plants in 2016 with the aim of monitoring the growth of plants over the growing season. The schedule returned to the original number of surveys and transects in 2018.

Year	Survey date	No. of transects	Distance surveyed (m)
2013	October	14	4,746
2014	August	26	8,120
2015	August	18	6,585
2016	June	19	12,468
	October	19	10,565
2017	May	19	12,204
	June	37	21,238
	August	37	22,148
	October	37	22,673
2018	May	19	11,943
	August	19	11,761
	October	19	11,975
2019	May	19	11,704
	August	19	11,981
	October	19	12,242
2020	June	19	10,092

Year	Survey date	No. of transects	Distance surveyed (m)
	August	19	11,796
	October	19	11,964
2021	May	19	11,897
	August	19	11,717
	October	19	11,692
2022	May	19	11,496
	August	19	10,799
	October	19	11,290
2023	May	19	11,981
	August	19	11,823
	October	19	12,970
2024	May	19	11,939
	August	19	11,671
	October	19	11,973

Acknowledgements

The Broads Authority would like to thank all those individuals and organisations who assisted during the 2025 survey season by providing their time, boats, identification skills or permissions.

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Appendix I: Common water plants in the Broads

Table 27

Details of Broads water plants

Group	Scientific name	Common name	Section 41
Stoneworts	*Chara aspera*	Rough stonewort	
	C. baltica	Baltic stonewort	Y
	C. connivens	Convergent stonewort	Y
	C. contraria	Opposite stonewort	
	C. curta	Lesser bearded stonewort	
	C. globularis	Fragile stonewort	
	C. hispida	Bristly stonewort	
	C. intermedia	Intermediate stonewort	Y
	C. pedunculata	Hedgehog stonewort	
	C. virgata	Delicate stonewort	
	C. vulgaris	Common stonewort	
	Nitella flexilis	Starry stonewort	Y
	N. mucronata	Pointed stonewort	
	N. translucens	Translucent stonewort	
Vascular macrophytes	*Acorus calamus*	Sweet flag	
	Crassula helmsii	Australian swamp stonecrop	
	Callitriche sp.	Starwort sp.	
	Ceratophyllum demersum	Rigid hornwort	
	Elodea canadensis	Canadian waterweed	
	E. nuttallii	Nuttall's waterweed	
	Eleogiton fluitans	Floating club-rush	
	Glyceria maxima	Reed sweet grass	
	Hippuris vulgaris	Mare's tail	
	Myriophyllum spicatum	Spiked water milfoil	
	M. verticillatum	Whorled water milfoil	
	Najas marina	Holly-leaved naiad	Y
	Persicaria amphibia	Amphibious bistort	
	Potamogeton acutifolius	Sharp-leaved pondweed	
	P. berchtoldii	Small pondweed	
	P. crispus	Curled pondweed	
	P. friesii	Flat-stalked pondweed	
	P. lucens	Shining Pondweed	
	P. natans	Broad –leaved pondweed	
	P. obtusifolius	Blunt-leaved pondweed	
	P. pectinatus	Fennel-leaved pondweed	
	P. perfoliatus	Perfoliate pondweed	
	P. pusillus	Lesser pondweed	
	P. trichoides	Hair like pondweed	
	Potamogeton x Salicifolius	Willow-leaved pondweed	
	Ranunculus circinatus	Fan-leaved water crowfoot	
	Rorippa nasturtium-aquaticum	Water cress	
	Saggitaria sagittifolia	Arrowhead	
	Sparganium erectum	Branched bur-reed	

	S. emersum	Unbranched bur-reed	
	Stratiotes aloides	Water-soldier	
	Utricularia vulgaris	Greater bladderwort	
	Zannichellia palustris	Horned pondweed	
Free-floating or Round floating leaved macrophytes	*Hydrocharis morsus-ranae*	Frogbit	
	Lemna gibba	Inflated duckweed	
	L. minor	Common duckweed	
	L. minuta	Least duckweed	
	L. trisulca	Ivy-leaved duckweed	
	Nuphar lutea	Yellow water lily	
	Nymphaea alba	White water lily	
	Spirodela polyrhiza	Greater duckweed	
Macro-algae & Mosses	*Enteromorpha*		
	Fontinalis antipyretica	Common water moss	
	Hydrodictyon	Water net	
	Leptodictyum riparium	Stringy moss	
	Zygnematales	Filamentous algae	

For more information about Stoneworts please see
https://www.yumpu.com/en/document/view/31414379/important-stonewort-areas-plantlife