Broads Annual Water Plant Monitoring Report 2015

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1 Executive Summary

This report presents and discusses the findings from the annual water plant surveys carried out during 2015, which covered 28 waterbodies. 2014 saw a switch from the transect based method that has been used to complete surveys since 1983, to a point based method which has been developed since 2011.

Key Results for 2015 can be summarised as:

- In response to the recent and on-going trend of mild winters, variable springs, and the subsequent earlier growing season for various species, the start of the survey season has been brought forward by two weeks to begin in early July and to conclude by the end of August. This slight shift ensures the peak growth of water plants is captured during the survey period.
- This year has seen a shift in dominant species in a number of regularly surveyed broads. However, it must be noted that water plants can be very variable between years and between broads. The underlying cause why a certain plant species outcompetes another in a particular year can be related to a whole host of reasons including; earlier growing season; water levels; nutrient availability, etc. Those broads which had a change in dominant species were; Alderfen, Buckenham, Heigham Sound, Hickling, Rockland and Whitlingham Little.
- Pondweed species (*Potamogeton sp.*) did not have a very productive year, with lower species numbers and reduced abundance, compared to recent years. The growing conditions early in the season when these species make most of their growth may have been a factor.
- Hickling Broad had a vigorous year for overall water plant abundance. Stonewort beds extended over most areas of the broad, but with relatively low height, other than in the most sheltered bays.
- At the Martham broads, the North Broad had a reduction in the number of species found this year, as bristly stonewort was very vigorous, at the expense of the previously dominant starry stonewort. In comparison the South Broad was relatively stable in terms of species present and overall growth levels.
- Cockshoot has seen very interesting this year, with a big reduction in species numbers, with only two species found in the broad this year. The broad contained an almost monoculture of the nationally scares holly-leaved naiad, with a small amount of rigid hornwort.
- Sotshole broad was formally surveyed this year for the first time using the standard methodology. Following extensive restoration work by the landowner, three species of water plant were found. It is early days in the recovery of this small site and hopefully a broader range of water plants will colonise over time.
- Wroxham Broad's species richness was very low, with small amounts of only two species found this year.
- Whitlingham Great Broad continues to have an impressive number of different species, however the 2015 abundance figures appear to be lower than in recent years. Whitlingham Little Broad appears to be decreasing slightly in terms of the

number of species present and the total water plant abundance. The annual presence of blue-green algae at this site is an on-going challenge for any water plant growth.

The point based survey method was implemented successfully and in general offers a much more consistent methodology across all the broads compared to the transect method. The data generated by the point survey methodology is robust, in terms of repeatability and representativeness from each site. However, there were some factors that influenced the speed with which the new methodology could be completed, so the total number of broads that can be surveyed in any one year has been slightly reduced.

As a classification and assessment tool the water plant surveys inform ways in which lake restoration works can be targeted and allow the success of any management to be assessed. The water plant monitoring also provides an early means to identify possible ecological deterioration of sites. The results of the water plant surveys contribute to the classification and monitoring of SSSI waterbodies in partnership with Natural England. The detection of invasive, non-native plant species within the Broads is also important function of the annual survey, if the risks posed by these plants are to be effectively managed.

Steady progress is being made through the Broads Biodiversity & Water Strategy, however much work remains to be done across the Broads to bring degraded broads back to health, in line with statutory drivers and to increase and subsequently maintain the diversity of those broads lacking in species richness. The annual water plant survey continues to be a valuable part of targeting and measuring the success of restoration efforts.

2 Aims & Objectives

The aim of the Broads annual survey in 2015 was to continue to monitor water plant growth within specified broads, but using the point based method across all selected sites. Following the analysis of data recorded in 2011 and 2013 whereby surveys were repeated on the same broads using both the historical transect method and the proposed point based method, Dr. Nigel Wilby, University of Stirling, has been advising the Broads Authority on the requirements of a point based method. A revised scoring mechanism has been implemented, to allow continuation of comparison of long term trends despite changes to the survey methodology used. Final feedback from Dr Wilby following this year's results is awaited.

Where broads have historically been sampled around a particular date, it is aimed that the survey takes place as near as possible to that date. The main objectives in the annual programme are to monitor key broads with long-term datasets, those that have had restoration measures put in place 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 and/or generally without plants, are monitored on a less frequent basis. When resources allow, a rolling program of monitoring sites not previously surveyed is also an ongoing aim.

3 Survey Methodology

Following a number of years of increasing plant growth and abundance across many of the broads, it has been widely acknowledged that the transect methodology employed for the

broads annual water plant survey was becoming increasingly difficult to implement. Revision of the methodological approach was carried out, to ensure the methodology produced a robust and consistent survey that would continue to allow analysis of long term trends.

Following consultation with Natural England, Environment Agency, Dr Nigel Wilby (University of Stirling) and other researchers, the decision was taken to adopt a point based survey methodology rather than the transect based method used since the annual water plant surveys' conception in 1982.

In 2011 and 2013 a number of sites were surveyed using both a point based and transect based method to enable analysis of the methods and to see if the data produced by the point based method could be directly comparable to the transect method. This method was fully adopted in 2014.

The methodology set out below, is based on advice the Authority received that suggested that long term trend analysis would still be possible.

3.1 Point Survey Method

Survey point selection

1. The area of open water of each broad to be surveyed was measured using the ArcGIS system.

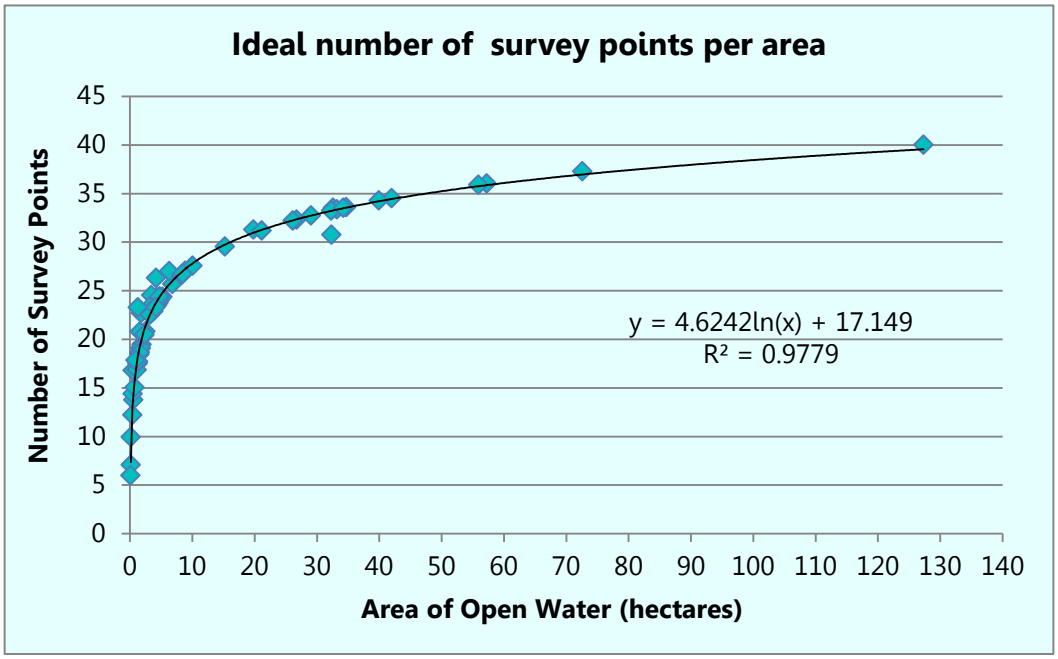

Figure 1. Chart depicting the implementation of survey point in relation to area of open water.

2. The equation y = 4.6242ln(x) + 17.149 was used to calculate the ideal number of survey points, where y = the area of open water in a site. This relationship was generated by Dr Nigel Wilby, based on Broad's species accumulation data. Once this number was calculated, a grid system was applied and a set of points was plotted on to the open water areas of each broad. Points were located equidistant apart.

3. An aerial photograph of each broad was produced on which each of the numbered survey points was marked. On the reverse of each map was a list of the grid references of each numbered point.

3.2 Field method

1. In the field, surveyors used the grid references of each plotted point to identify the point's location. The survey boat navigated to each point using a handheld GPS device. Once within 5 m of the plotted grid reference, mud weights were deployed to keep the boat in the correct location.
2. At each point, a 5 m rake throw was completed to the north and to the south. Each sample (either north or south) was recorded separately, for subsequent analysis. Two samples at each point has been previously been found to be a representative number of samples at each point.
3. A double headed survey rake was thrown 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 along the bed of the broad, back towards the boat. For points that were in 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.
4. On retrieval of each 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.
5. 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.
6. Any plant specimens where identification in the field was uncertain were collected in plastic bags, labelled using the station number reference and the direction of the throw which is the point. This is then taken for subsequent observation using a high powered microscope, or to be sent for expert identification. Wherever possible, voucher specimens were pressed and dried using standard herbarium techniques.
7. To assign a level of abundance, each species collected was given an abundance score of between 1 and 10. The score assigned should take into account the trap-ability of a particular species on the rake so that a score of 10 (91 to 100%) represents the maximum amount trappable on the rake for any particular species. As an example, a fine leaved species such as unbranched bur-reed would not be as trappable on the rake as a more structured species such as spiked water milfoil and therefore for scoring a rake pull of these species of equal volume, the score for unbranched bur-reed would be higher than for spiked water milfoil.

0.1 = <1%

1 = 1 to 10%	6 = 51 to 60%
2 = 11 to 20%	7 = 61 to 70%
3 = 21 to 30%	8 = 71 to 80%
4 = 31 to 40%	9 = 81 to 90%
5 = 41 to 50%	10 = 91 to 100%

8. The maximum total of all species abundance scores on an individual rake sample cannot really be more than 100%, plus or minus 10% tolerance to account for the varying trap-ability of different species.

3.3 Data processing

1. For each sample, species abundance scores can be totalled, to produce the total abundance score for each sample. Sum of all sample abundance scores produces the site total abundance. Assuming maximum plant abundance on the site, the site abundance score should have a maximum of 10 (± 10%).
2. For data comparison, the results have been calculated to show the species richness (number of species recorded) and the species abundance scores. Species abundance is calculated by summing all the abundance scores for a particular species at each site and dividing by the number of samples, which were surveyed for that site. Within each sites results table, the species abundances have been displayed in descending order so that the most abundant species in 2015 are listed at the top of each site table.

Table 1. Sites surveyed for water plants from 1983 to 2014, sites that the Norfolk Wildlife Trust now survey are in orange

Broad	Times sampled	Year Sampled																																
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Alderfen	33	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Bargate	4																						■		■						■		■	
Barnby	7																						■	■	■	■		■			■			■
Barton	33	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Belaugh	20							■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■			■	■				
Blackfleet	3	■		■																					■									
Bridge	15														■	■	■	■	■	■	■		■	■	■	■	■		■		■			■
Buckenham	10																						■	■	■	■	■	■	■	■		■		■
Burntfen	6																■					■			■				■	■		■		
Calthorpe	7																■					■			■				■	■	■		■	
Catfield	3																								■			■						■
Cockshoot	33	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cockshoot Dyke	30	■	■	■	■	■	■	■	■	■	■	■	■	■					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cromes South	32	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cromes North	30	■	■	■	■	■	■	■	■	■	■	■		■		■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■
Decoy	11				■												■						■	■	■	■	■	■	■			■	■	
Filby	25	■	■	■	■	■		■	■	■	■			■	■	■	■	■	■		■	■	■	■	■	■	■		■	■	■			
Flixton Decoy	3																								■	■			■					
Fritton Lake	1																								■									
Hassingham	10																						■	■	■	■	■	■	■	■		■		■
Heigham Sound	25	■	■	■	■	■	■	■	■	■	■	■	■		■	■								■	■	■	■	■	■	■	■	■	■	■
Hickling	33	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Horsey Mere	29	■	■	■	■	■		■	■	■	■			■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hoveton Great	33	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Hoveton Little	15							■						■	■	■	■	■	■	■			■	■	■	■	■					■	■	
Hudson's Bay	9	■	■	■		■		■							■											■					■			■
Irstead	2																						■					■						
Lily	26	■	■	■	■	■		■	■	■	■			■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■
Little	5																							■			■	■	■			■		
Malthouse	7													■	■		■		■	■	■								■					
Martham North	32	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Martham South	31	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Broad	Times sampled	Year Sampled																																
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mautby Decoy	4																																	
Norton	4																																	
Ormesby	27																																	
Ormesby Little	27																																	
Pound End	16																																	
Ranworth	31																																	
Reedham Water	3																																	
Rockland	25																																	
Rollesby	26																																	
Round Water	2																																	
Salhouse Great	13																																	
Salhouse Little	6																																	
Sotshole	5																																	
Spratts Water	3																																	
Strumpshaw	10																																	
Upton Great	33																																	
Upton Little	10																																	
Wheatfen	7																																	
Whitlingham Great	12																																	
Whitlingham Little	11																																	
Woolners Carr	1																																	
Wroxham	33																																	
Total no. broads sampled per year		23	22	23	23	24	15	24	22	23	23	17	13	27	27	26	32	21	26	19	22	22	37	35	41	42	35	33	36	34	32	26	24	28

Table 2 Survey dates (2009-2014).

Broad	Survey Date						
	2009	2010	2011	2012	2013	2014	2015
Alderfen	19-Aug	03-Aug	09-Aug	14-Aug	14-Aug	14-Aug	30-Jul
Bargate		-	-	31-Aug	-	03-Sep	-
Barnby	14-Aug	-	-	19-Jul	-		04-Aug
Barton	12-Aug	21-Jul	04-Aug	06-Aug	09-Aug	07-Aug	07-Aug
Belaugh		05-Aug	11-Aug	-	-		-
Blackfleet							-
Bridge Broad		-		03-Aug	-		14-Aug
Buckenham Broad		30-Jul	20-Jul	-	26-Jul		28-Jul
Burntfen		12-Aug	01-Sep	-	20-Aug		-
Calthorpe	-	03-Sep	17-Aug	11-Sep	-	02-Sep	-
Cockshoot Broad	03-Sep	01-Sep	18-Aug	29-Aug	05-Sep	27-Aug	20-Aug
Catfield	03-Sep	-	-	-	-	-	21-Aug
Crome's	19-Aug	03-Aug	08-Aug	14-Aug	08-Aug	06-Aug	29-Jul & 07-Aug
Decoy Broad	05-Aug	-	-	-	23-Aug	01-Sep	-
Flixton Decoy	-	06-Aug	-	-	-	-	-
Hassingham Broad	28-Aug	30-Jul	20-Jul	-	26-Jul	-	24-Jul
Heigham Sound	07-Aug	23-Aug	29-Jul	26-Jul	02-Aug	22-Jul	14-Jul
Hickling	13-Aug	23-Jul	05-Aug	25-Jul	31-Jul	23-Jul	15-Jul
Horsey Mere	07-Aug	28-Jul	29-Jul	31-Jul	30-Jul	24-Jul	16-Jul
Hoveton Great	06-Aug	05-Aug	03-Aug	06-Sep	13-Aug	12-Aug	05-Aug
Hoveton Little	-	-	-	-	15-Aug	13-Aug	-
Hudsons Bay	-	-	-	06-Sep	-	-	06-Aug
Irstead Holmes	04-Aug	-	-	-	-	-	-
Malthouse	-	17-Aug	-	-	-	-	-
Martham Broad North	30-Jul	29-Jul	25-Jul	24-Jul	25-Jul	29-Jul	21-Jul
Martham Broad South	30-Jul	29-Jul	26-Jul	24-Jul	24-Jul	30-Jul	22-Jul
Mautby Decoy	09-Sep	02-Sep	-	-	-	-	-
Mill Water	-	-	-	-	-	-	-
Nortons	29-Jul	05-Aug	11-Aug	-	-	-	-
Pound End	-	-	-	-	23-Aug	-	06-Aug
Ranworth	21-Aug	31-Aug	16-Aug	02-Aug	28-Aug	02-Sep	31-Jul
Rockland	-	30-Aug	25-Aug	30-Aug	-	28-Aug	11-Aug
Reedham	04-Aug	-	-	-	-	31-Jul	-
Round Water	-	-	23-Aug	-	-	-	-
Salhouse Great	-	-	-	08-Aug	-	-	-
Salhouse Little	-	-	-	08-Aug	-	-	-
Sotshole	-	-	-	-	-	-	04-Aug
Spratt's Water	-	-	23-Aug	-	-	-	-
Strumpshaw	-	30-Jul	20-Jul	27-Jul	01-Aug	-	13-Aug
Upton Great	18-Aug	13-Aug	10-Aug	22-Aug	21-Aug	19-Aug	18-Aug
Upton Little	18-Aug	13-Aug	-	22-Aug	22-Aug	20-Aug	-
Wheatfen	-	-	-	30-Aug	-	-	12-Aug
Whitlingham Great	28-Aug	-	19-Jul	18-Jul	17-Jul	17-Jul	08-Jul
Whitlingham Little	28-Aug	30-Aug	19-Jul	18-Jul	17-Jul	17-Jul	08-Jul
Woolners Carr	-	-	23-Aug	-	-	-	-
Wroxham	04-Aug	04-Aug	21-Jul	03-Aug	06-Aug	05-Aug	23-Jul

4 Broads Water plant Results.

Each broad that was surveyed in 2015 is reviewed in terms of 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 Section 3).

Due to the change of methodology, comparisons and analysis of recent trends of plant abundance have not been made at this time. However, discussion around the species richness on sites has been included with summary tables displaying which species were recorded during the previous two survey attempts.

The results tables also illustrate how many points each species was recorded at giving an indication of the distribution.

Appendix 1 classifies the plants into groups of similar form/structure. Appendix 2 lists the common and Latin names for all plants found to date during broads surveys.

4.1 Thurne Valley

The broads which are located in the Thurne valley contain one of the most diverse populations of stoneworts in the UK.

The Broads within the Thurne catchment are a haven for vulnerable and rare species these are stated in the Joint Nature Conservation Committee (JNCC) Red Data Book, they include; three 'Vulnerable' species: baltic stonewort, convergent stonewort and starry stonewort, and one 'rare' species: intermediate stonewort (Stewart and Church, 1992). The broads within the Thurne valley also provide a stronghold for the rare BAP species holly-leaved naiad, as well as more common vascular plants such as spiked water milfoil and mare's tail.

4.1.1 Heigham Sound

Common Name	Scientific Name	Present		Species Abundance 2015	Number of samples where recorded
		2013	2014		
Mare's tail	*Hippuris vulgaris*	*	*	0.695	15
Spiked water milfoil	*Myriophyllum spicatum*	*	*	0.431	22
Intermediate stonewort	*Chara intermedia*		*	0.258	4
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.248	14
Stonewort (*Nitella*) species	*Nitella sp.*			0.098	5
Curled pondweed	*Potamogeton crispus*	*	*	0.037	5
Fan-leaved water crowfoot	*Ranunculus circinatus*	*	*	0.029	9
Canadian waterweed	*Elodea canadensis*	*	*	0.018	2
Holly-leaved naiad	*Najas marina*			0.018	2
Nuttall's waterweed	*Elodea nuttallii*	*	*	0.016	1
Starry stonewort	*Nitellopsis obtusa*	*	*		
Lesser pondweed	*Potamogeton pusillus*	*	*		
Filamentous algae	*Zygnematales*		*		
Fragile/Convergent stonewort	*Chara globularis/connivens*				
Total number of species recorded		**9**	**11**	**10**	**Total samples taken 62**

The abundance of mare's tail has increased slightly this year and is now the most abundant plant. Conversely spiked water milfoil which has been the most abundant for a number of years is down considerably on last year's abundance score and it was only found on 35 percent of the points compared to last year's 80 percent. Holly leaved naiad was found at two points.

Small amounts of a stonewort *Nitella* species were found that were not large enough or in a suitable condition to be correctly identified. It is most likely that these specimens were starry stonewort, but could not be confirmed.

4.2 Horsey Mere

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Mare's tail	*Hippuris vulgaris*	*	*	1.171	23
Spiked water milfoil	*Myriophyllum spicatum*	*	*	0.048	14
Filamentous algae	*Zygnematales*			0.003	2
Fennel-leaved pondweed	*Potamogeton pectinatus*	*		0.002	1
Willow-leaved stonewort	*Potamogeton x salicifolius*		*		
Stonewort (*Chara*) species	*Chara sp.*	*			
Total number of species recorded		**4**	**4**	**4**	**Total samples taken 66**

Four species were collected in Horsey Mere in 2015. Mare's tail and spiked water milfoil continue to be the main species encountered here.

Mare's tail abundance has increased and was found at more locations, it appears to mostly be along the south west edge of the broad with a small in the northwest of the broad. Spiked water milfoil's abundance has decreased considerably as has the number of points where it was recorded.

A species of starwort (Callitriche sp.) was found near the entrance of Waxham New Cut, however it was not acquired during the sample collection.

4.2.1 Hickling

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Intermediate stonewort	*Chara intermedia*	*	*	1.214	56
Spiked water milfoil	*Myriophyllum spicatum*	*	*	0.300	35
Holly-leaved naiad	*Najas marina*	*	*	0.255	32
Baltic stonewort	*Chara baltica*	*	*	0.218	20
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.068	6
Bristly stonewort	*Chara hispida*			0.041	3
Fragile/Convergent stonewort	*Chara globularis/connivens*	*	*	0.027	12
Rough stonewort	*Chara aspera*			0.026	2
Rigid hornwort	*Ceratophyllum demersum*	*		0.015	3
Mare's tail	*Hippuris vulgaris*			0.013	1
Convergent stonewort	*Chara connivens*	*		0.003	2
Stonewort (Cara) species	*Chara sp.*			0.003	2
Common stonewort	*Chara vulgaris*			0.001	1
Filamentous algae	*Zygnematales*			0.001	1
Fan-leaved water crowfoot	*Ranunculus circinatus*			0.001	1
Opposite stonewort	*Chara contraria*	*	*		
Curled pondweed	*Potamogeton crispus*	*	*		
Willow-leaved stonewort	*Potamogeton x salicifolius*	*			
Total number of species recorded		**11**	**8**	**15**	**Total samples taken 78**

An excellent year for species diversity and abundance in Hickling broad, finding potentially fifteen species compared to last year's eight and eleven the year before. Stoneworts were widespread across the broad this year, with six confirmed species. The rare intermediate stonewort became the most abundant species found in the broad, located at 56 of the 78 survey points. Baltic stonewort increased notably on last year. Dense beds were seen in the sheltered bay behind Pleasure Island.

Holly-leaved naiad also had a good year as the third most abundant species, again increased on last year's abundance score and number of points where it was recorded.

Perhaps in response water milfoils and pondweeds did not have as good a year, spiked water milfoil which was been the dominant species since 2010 was considerably down on last year's score. Fennel-leaved pondweed was the only pondweed found this year; its abundance has also decreased.

Martham North and South

For many years, the Martham Broads have been characterised by sustained clear water conditions, resulting from a supply of largely good quality freshwater draining from the area to the northeast of the broads. These conditions generally continue and are reflected in the high diversity of the plant communities found in the most recent surveys.

4.2.2 Martham North

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Bristly stonewort	*Chara hispida*	*	*	6.706	43
Filamentous algae	*Zygnematales*	*	*	0.762	9
Horned pondweed	*Zannichellia palustris*	*		0.142	7
Holly-leaved naiad	*Najas marina*	*	*	0.128	10
Starry stonewort	*Nitellopsis obtusa*	*	*	0.116	12
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.050	10
Rough stonewort	*Chara aspera*		*	0.040	1
Mare's tail	*Hippuris vulgaris*	*		0.020	1
Common water moss	*Fontinalis antipyretica*	*		0.002	1
Intermediate stonewort	*Chara intermedia*	*	*		
Baltic stonewort	*Chara baltica*	*	*		
Fragile/Convergent stonewort	*Chara globularis/connivens*		*		
Opposite stonewort	*Chara contraria*	*	*		
Stonewort (Cara) species	*Chara sp.*		*		
Whorled water milfoil	*Myriophyllum verticillatum*	*	*		
Yellow water lily	*Nuphar lutea*	*			
White water lily	*Nymphaea alba*	*			
Spiked water milfoil	*Myriophyllum spicatum*	*			
Starwort species	*Callitriche sp.*	*			
Total number of species recorded		**16**	**12**	**9**	**Total samples taken 50**

Fewer species were once again recorded from Martham North following a downward trend since 2013, though overall plant abundance remains high. Bristly stonewort was the most widespread covering 43 of the 50 points surveyed. Its abundance score was also up on last year.

Horned pondweed has considerably increased on its abundance scores attained in 2013, to become the third most abundant species. Filamentous algae has reduced compared to last year's score, but is still the second most abundant species. It featured at nine points compared to last year's twenty, with a distribution exclusively adjacent to the navigation channel

Significant reduction in the diversity of the stonewort species has occurred this year, with bristly stonewort becoming dominant, to the exclusion of other species.

Frogbit was observed in the margins during the survey but not recorded when sampling.

4.2.3 Martham South

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Bristly stonewort	*Chara hispida*	*	*	7.842	48
Baltic stonewort	*Chara baltica*	*	*	0.340	8
Filamentous algae	*Zygnematales*	*	*	0.260	3
Holly-leaved naiad	*Najas marina*	*	*	0.130	8
Convergent stonewort	*Chara connivens*		*	0.120	5
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.046	5
Canadian waterweed	*Elodea canadensis*	*		0.040	2
Fragile/Convergent stonewort	*Chara globularis/connivens*			0.020	1
Intermediate stonewort	*Chara intermedia*	*	*	0.020	1
Spiked water milfoil	*Myriophyllum spicatum*	*	*	0.008	4
Hedgehog stonewort	*Chara aculeolata*		*	0.004	2
Rough stonewort	*Chara aspera*		*	0.004	2
Enteromorpha	*Enteromorpha*			0.004	2
Mare's tail	*Hippuris vulgaris*	*	*	0.004	2
Ivy-leaved duckweed	*Lemna trisulca*			0.004	2
Starry stonewort	*Nitellopsis obtusa*	*	*	0.004	2
Starwort species	*Callitriche sp.*	*		0.002	1
Stonewort (*Nitella*) species	*Nitella sp.*			0.002	1
Fan-leaved water crowfoot	*Ranunculus circinatus*	*		0.002	1
Delicate stonewort	*Chara virgate*		*		
Common stonewort	*Chara vulgaris*		*		
Curled pondweed	*Potamogeton crispus*		*		
Willow-leaved stonewort	*Potamogeton x salicifolius*	*			
Yellow water lily	*Nuphar lutea*	*			
Opposite stonewort	*Chara contraria*	*			
Rigid hornwort	*Ceratophyllum demersum*	*			
Arrowhead	*Saggitaria sagittifolia*	*			
Pondweed species	*Potamogeton sp.*	*			
Whorled water milfoil	*Myriophyllum verticillatum*	*			
Total number of species recorded		**19**	**15**	**19**	**Total samples taken 50**

This year 19 species were recoded from Martham South, in the same as 2013, but the composition and quantity of the species was very different. Bristly stonewort the most abundant species in 2014 has continued to dominate, increasing its abundance score and expanding its range, located at 96% of the points. Baltic stonewort increased being found at twice the number of points compared to last year.

Starry stonewort's presence here has severely decreased, much like on Martham North. From once being the second most abundant species in 2014 to only being located at two points in trace amounts in 2015. In addition many of the other species have also decreased, intermediate stonewort and Hedgehog stonewort once quite frequent are now only found on a couple of points. This trend has also occurred in the vascular plants. The abundance of spiked water milfoil, mare's tail and fennel-leaved pondweed have also decreased this year.

4.3 Ant Valley

In the Ant Valley, Alderfen, Cromes and Barton broad were some of the first broads surveyed in 1983 and have been regularly surveyed since. These water bodies have been subject to extensive restoration effort over the last 25 years, and all have improved water quality. Alderfen and Cromes have abundant and stable populations of rigid hornwort, although this species tends to be indicative of higher nutrient conditions.

4.3.1 Alderfen

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Rigid hornwort	*Ceratophyllum demersum*	*	*	2.863	46
Holly-leaved naiad	*Najas marina*	*	*	0.348	17
Filamentous algae	*Zygnematales*	*	*	0.044	21
Fragile/Convergent stonewort	*Chara globularis/connivens*		*	0.004	2
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.004	2
Fragile stonewort	*Chara globularis*	*			
Lesser pondweed	*Potamogeton pusillus*	*			
Water net algae	*Hydrodictyon sp.*		*		
Total number of species recorded		**6**	**6**	**5**	**Total samples taken 48**

The dominant species this year were rigid hornwort and holly-leaved naiad, compared to the filamentous algae and rigid hornwort dominance of 2014. Indeed filamentous algae was only recorded in trace amounts throughout the broad this year and then only at 44% of the points. Holly-leaved naiad summary abundance was down from last year's (0.480) but recorded at five more points, which means that it was recorded in lesser quantity, but at more points.

4.3.2 Barton

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.276	16
Yellow water lily	*Nuphar lutea*	*	*	0.043	2
Canadian waterweed	*Elodea canadensis*	*	*	0.031	3
Pondweed species	*Potamogeton sp.*			0.029	2
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.003	2
Nuttall's waterweed	*Elodea nuttallii*	*	*		
Curled pondweed	*Potamogeton crispus*	*			
Lesser pondweed	*Potamogeton pusillus*	*			
Frogbit	*Hydrocharis morsus-ranae*	*			
Total number of species recorded		**8**	**5**	**5**	**Total samples taken 72**

Barton broad continues to have very low plant abundance, this year being no exception. Five different species were recorded this year, with fennel-leaved pondweed being the most abundant, being recorded at 16 of the 72 points.

The next most abundant was yellow water lily, found at the entrance to Hall Dyke, in the north-west of the broad. Then it was Canadian waterweed which was only recorded at from three samples, the former only at the entrance to Hall Dyke Rigid hornwort was only found in two samples in the southern half of the broad, known as Turkey Broad.

The white water-lily was also observed near Hall Dyke, however it was not recorded in the samples.

4.3.3 Cromes Broad

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Filamentous algae	*Zygnematales*	*	*	3.150	31
Delicate stonewort	*Chara virgata*			1.217	12
Greater bladderwort	*Utricularia vulgaris*	*	*	0.479	13
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.136	12
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.095	4
Common stonewort	*Chara vulgaris*			0.071	2
Fragile stonewort	*Chara globularis*	*	*	0.048	1
Canadian waterweed	*Elodea canadensis*		*	0.048	2
Common duckweed	*Lemna minor*		*	0.048	2
Enteromorpha	*Enteromorpha*	*	*	0.024	1
Stonewort (*Chara*) species	*Chara sp.*			0.002	1
Nuttall's waterweed	*Elodea nuttallii*	*	*		
Fragile/Convergent stonewort	*Chara globularis/connivens*		*		
Small pondweed	*Potamogeton berchtoldii*		*		
Unbranched bur-reed	*Sparganium emersum*		*		
Water soldier	*Stratiotes aloides*		*		
Common water moss	*Fontinalis antipyretica*	*			
Water net algae	*Hydrodictyon sp.*	*			
Lesser pondweed	*Potamogeton pusillus*	*			
Total number of species recorded		**10**	**13**	**11**	**Total samples taken 42**

Historically Cromes broad has been split into two distinct areas north and south, a reed strip on top of an old peat baulk separates the north and south basins. Both basins have been previously dredged or mud pumped, historically the southern basin has had a greater abundance of species than the northern basin. However over the last few years there has been some improvement in the diversity of the plants in this northern basin probably due to the increased water depth from the mud pumping during the winter of 2004/5.

In the winter of 2012/13 a project was conducted which released a product called Phoslock into the water body, this clay product binds phosphate to it, thereby reducing the phosphate availability for planktonic algal growth.

Filamentous algae is the most abundant species in Cromes broad being found at 31 of the 42 points, however 20 of these points are located in the northern basin, which is all the points therein. The majority of these points collected substantial amount of this algae, whereas at the 11 points in the southern basin it was collected only in small quantities.

The southern basin also had a greater range of species, nine compared with norths four. The difference comprised of all the Chara listed and greater bladderwort.

The summary abundance of filamentous algae was less than in 2014 and, delicate stonewort, was the second abundant species. Greater bladderwort was down considerably on last year which was 2014 second most abundant species.

Common reed and greater reedmace were noted at few points around the edge of the broad Marginal species such as water dock, greater water-parsnip and common water-plantain were also found at some of those points all of which could indicate that the reedbed is beginning to colonise out from the margins. Yellow and white water lily were also observed in the north basin but not recorded in the collected samples.

4.3.4 Catfield

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2006	2009		
Filamentous algae	*Zygnematales*	*	*	6.467	28
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.127	10
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.083	6
Enteromorpha	*Enteromorpha*			0.013	6
Canadian waterweed	*Elodea canadensis*	*	*		
Common duckweed	*Lemna minor*		*		
Fragile stonewort	*Chara globularis*		*		
Mare's tail	*Hippuris vulgaris*		*		
Blunt-leaved pondweed	*Potamogeton obtusifolius*	*			
Frogbit	*Hydrocharis morsus-ranae*	*			
Least duckweed	*Lemna minuta*	*			
Whorled water milfoil	*Myriophyllum verticillatum*	*			
Total number of species recorded		**9**	**7**	**4**	**Total samples taken 28**

This is a small, shallow broad, infrequently surveyed, but included here as part of the Ant Broads & Marshes SSSI. It was last surveyed in 2009 and before that in 2006 the overwhelmingly dominant species in 2015 was filamentous algae, being found at every one of the points and in large quantities.

Common reed has also encroached into this small broad, one survey point is now within a reedbed, a few other points close to the edge are in danger of becoming reedbed also.

The most diverse area of the broad is within the dyke leading to the boat house where there is species of pondweed and frogbit.

4.4 Bure Valley

In recent years Upton and Cockshoot Broads, both isolated from the river, have been a stronghold for the rare holly-leaved naiad. Those broads directly connected to the river, such as Wroxham, Ranworth, and Hoveton Great tends to have minimal plant diversity, although Bridge broad tends to buck that trend. Sotshole has been included in this year's survey after an absence of 16 years.

4.4.1 Bridge broad

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2008	2012		
Unbranched bur-reed	*Sparganium emersum*	*	*	1.031	19
Filamentous algae	*Zygnematales*	*	*	0.672	23
Yellow water lily	*Nuphar lutea*	*	*	0.389	7
Nuttall's waterweed	*Elodea nuttallii*	*		0.336	13
Rigid hornwort	*Ceratophyllum demersum*			0.306	7
Long-stalked pondweed	*Potamogeton praelongus*			0.086	3
Common duckweed	*Lemna minor*			0.031	2
Starwort species	*Callitriche sp.*	*		0.028	1
Enteromorpha	*Enteromorpha*		*		
Canadian waterweed	*Elodea canadensis*		*		
Branched bur-reed	*Sparganium erectum*	*			
Total number of species recorded		**6**	**5**	**8**	**Total samples taken 38**

This broad was last surveyed in 2012 and at that time filamentous algae was the most abundant species, before that in 2008 it was unbranched bur-reed. In 2015 unbranched bur-reed has regained the title of the most abundant with filamentous algae a close second.

More species were found this year than in previous years. The increase in species richness and abundance may be reflective of improvements in water clarity observed in the main river.

4.4.2 Cockshoot

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Holly-leaved naiad	*Najas marina*	*	*	3.583	36
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.117	10
Filamentous algae	*Zygnematales*	*	*		
Horned pondweed	Zannichellia palustris	*	*		
Fragile/Convergent stonewort	*Chara globularis/connivens*	*	*		
Enteromorpha	*Enteromorpha*	*	*		
Opposite stonewort	*Chara contraria*	*	*		
Canadian waterweed	*Elodea canadensis*	*	*		
Lesser pondweed	*Potamogeton pusillus*	*	*		
Common duckweed	*Lemna minor*	*			
Common stonewort	*Chara vulgaris*	*			
Fragile stonewort	*Chara globularis*	*			
Total number of species recorded		**12**	**9**	**2**	**Total samples taken 48**

This has been a very different and surprising year for Cockshoot Broad. The dominant species is holly-leaved naiad, found on 36 of the 48 points; it was the most abundant species throughout the broad, to the extent that only one other species was found there this year.

Filamentous algae was not seen on the broad this year although large amounts of it were found dead within Cockshoot dyke.

The end of Cockshoot Dyke nearest the broad was also surveyed but only included in this discussion for interest; the most abundant species here, besides the dead filamentous algae, was rigid hornwort. Other species observed in the dyke but not recorded in the point survey included; common reed, common water-plantain, white water lily and frogbit.

4.4.3 Hoveton Great

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.327	36
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.005	3
Nuttall's waterweed	*Elodea nuttallii*	*	*	0.002	1
Filamentous algae	*Zygnematales*	*	*	0.002	1
Yellow water lily	*Nuphar lutea*	*	*		
Curled pondweed	*Potamogeton crispus*	*	*		
Total number of species recorded		**6**	**6**	**4**	**Total samples taken 60**

This broad typically has low species richness, with this year species numbers decreased further. For example curled pondweed and yellow water lily were not recorded in this year's points, although it was seen around the edges of sheltered bays.

Rigid hornwort was found at 36 of the 60 points within the broad, but only in small quantities.

Larger quantities of yellow water lily, fennel-leaved pondweed and rigid hornwort were observed in an area outside the survey called The Dam which links the broad with the river.

4.4.4 Hudson's Bay

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2007	2012		
Yellow water lily	*Nuphar lutea*	*	*	0.473	17
Filamentous algae	*Filamentous algae*		*	0.125	13
White water lily	*Nymphaea alba*	*	*	0.025	1
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.013	5
Canadian waterweed	*Elodea canadensis*	*			
Total number of species recorded		**4**	**4**	**4**	**Total samples taken 40**

Hudson's Bay is a quite shallow broad connected to Hoveton Great Broad and typically has low levels of species richness.

Yellow water lily and filamentous algae were the most abundant plants being found at 42% and 32% of the points respectively, both species cover the surface of the water blocking out light which limits the growth of other vegetation. Rigid hornwort was the only other species to be found within the broad and was recorded from 5 points.

4.4.5 Pound End

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2008	2013		
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.018	8
Filamentous algae	*Zygnematales*	*	*	0.007	3
Holly-leaved naiad	*Najas marina*	*	*	0.007	3
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.002	1
Total number of species recorded		**4**	**4**	**4**	**Total samples taken 44**

Pound End is a quiet, and distinct section of Hoveton Little broad, being separated by a narrow strip of land, and has no boating access.

Fennel-leaved pondweed was the most abundant species, but even then it was only found at eight of the 44 points. Holly-leaved naiad is present at this broad, however along with the other species recorded it was only found in trace amounts.

4.4.6 Ranworth

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.002	1
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.002	1
Filamentous algae	*Zygnematales*			0.002	1
Common water moss	*Fontinalis antipyretica*	*			
Total number of species recorded		**3**	**2**	**3**	**Total samples taken 66**

Ranworth broad continues to have very low plant abundance and species diversity. The three species which were recorded there during the survey were only found in trace amounts, all of which were at the west side of the broad close to the shore.

This broad contains a bio-manipulation ring which excludes fish and provides a refuge for zooplankton which in turn improves water clarity by eating all the green planktonic algae. A large population of zebra mussels has also developed on the ring structure, which further increases the filtration of the water within the biomanipulation ring. Plants observed within this ring (though not formally recorded as sample points) included; fennel-leaved pondweed, Nuttall's waterweed, and holly-leaved naiad, thus showing that this broad has potential for reasonable water plant abundance and diversity, once water clarity is achieved.

4.4.7 Sotshole

Common Name	Scientific Name	Summary Abundance 2015	Number of samples where recorded
Enteromorpha	*Enteromorpha*	0.073	3
Filamentous algae	*Zygnematales*	0.033	1
Nuttall's waterweed	*Elodea nuttallii*	0.010	3
Total number of species recorded		**3**	**Total samples taken 30**

2015 was the first year that this site was formally surveyed; previously the owner had carried out a project of expansion and sediment removal. When enteromorpha and filamentous algae are found in large quantities on a body of water it is an indicator that it is affected by excessive nutrient availability. However at Sotshole Broad these species were found in low quantities in only a few points, so eutrophication may not be the foremost factor relating to its dearth in species abundance. Hopefully now with its greater size and depth a broader range of water plant species will colonise over time.

4.4.8 Upton Great

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Holly-leaved naiad	*Najas marina*	*	*	4.607	40
Opposite stonewort	*Chara contraria*	*	*	1.415	11
Common stonewort	*Chara vulgaris*	*	*	0.391	2
Filamentous algae	*Zygnematales*	*	*	0.004	2
Fragile/Convergent stonewort	*Chara globularis/connivens*		*		
Bristly stonewort	*Chara hispida*		*		
Stonewort species	*Chara sp.*		*		
Total number of species recorded		**4**	**7**	**4**	**Total samples taken 46**

The number of species within Upton Great has been relatively consistent over the years, the increase shown in 2014 is due to the detection of two traces of different stonewort species and an unidentified one. The diversity of plants within the broad is generally low, but with relatively high abundances.

Upton Great is a stable stronghold for holly-leaved naiad, interestingly this year it appears to be increasing to the detriment of opposite stonewort, as there was a reduction in the number of locations where it was found.

4.4.9 Wroxham

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.153	25
Fennel-leaved pondweed	*Potamogeton pectinatus*	*	*	0.114	20
Filamentous algae	*Zygnematales*	*	*	0.002	1
Horned pondweed	*Zannichellia palustris*			0.002	1
Nuttall's waterweed	*Elodea nuttallii*	*	*		
Unbranched bur-reed	*Sparganium emersum*	*	*		
Pointed stonewort	*Nitella mucronata*		*		
Yellow water lily	*Nuphar lutea*	*	*		
Starwort species	*Callitriche sp.*	*			
Common water moss	*Fontinalis antipyretica*	*			
Total number of species recorded		**8**	**7**	**4**	**Total samples taken 64**

This year showed a decrease in the species richness in Wroxham Broad. This is in contrast to the results from the 2013 and 2014 surveys which showed an increase in the species richness. The number of species found has gone down as has their abundance scores. Rigid hornwort was down by 76%, fennel-leaved pondweed was down by 63% and Nuttall's waterweed was not recorded.

Nevertheless, a species which has not been recorded since 2011 has resurfaced, horned pondweed, found at one point and in very small quantities.

Yellow water lily was observed in the sheltered bay in the north of the broad but not recorded in the point survey.

4.5 Yare Valley

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

4.5.1 Buckenham

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2011	2013		
Rigid hornwort	*Ceratophyllum demersum*	*	*	3.663	36
Filamentous algae	*Zygnematales*	*	*	2.871	36
Whorled water milfoil	*Myriophyllum verticillatum*	*	*	0.421	22
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.034	13
Potamogeton species	*Potamogeton sp.*			0.029	2
Fragile/Convergent stonewort	*Chara globularis/connivens*		*	0.005	2
Common water moss	*Fontinalis antipyretica*	*	*		
Fennel-leaved pondweed	*Potamogeton pectinatus*		*		
Yellow water lily	*Nuphar lutea*		*		
Common duckweed	*Lemna minor*		*		
Fan-leaved water crowfoot	*Ranunculus circinatus*	*			
Total number of species recorded		**6**	**9**	**6**	**Total samples taken 38**

Buckenham Broad is the western most of the two broads connected to Fleet Dyke; it is a picturesque isolated broad which generally has good water clarity and a good abundance of plant species.

As in previous years filamentous algae is one of the most dominant species within the broad, however this year rigid hornwort has increased and was the most abundant.

Other plant species which were observed but were not collected in the point samples include, frogbit, yellow water lily and water-soldier, these were located in sheltered areas along the edges of the broad. Interestingly Fresh water sponges were found within this broad there were usually attached to the plants like rigid hornwort and thus found when the samples were retrieved.

4.5.2 Hassingham

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2011	2013		
Rigid hornwort	*Ceratophyllum demersum*	*	*	6.121	34
Filamentous algae	*Zygnematales*	*	*	0.894	12
Holly-leaved naiad	*Najas marina*			0.603	15
Curled pondweed	*Potamogeton crispus*	*		0.371	13
Fragile/Convergent stonewort	*Chara globularis/connivens*	*	*	0.074	8
Whorled water milfoil	*Myriophyllum verticillatum*			0.032	2
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.009	3
Stonewort (Chara) species	*Chara sp*			0.003	1
Fragile stonewort	*Chara globularis*	*	*		
Bristly stonewort	*Chara hispida*		*		
Common water moss	*Fontinalis antipyretica*	*			
Fennel-leaved pondweed	*Potamogeton pectinatus*	*			
Total number of species recorded		**8**	**6**	**8**	**Total samples taken 34**

Hassingham is the sister broad to Buckenham. It usually has a good collection of species and has excellent water clarity.

Rigid hornwort is the most abundant species found at all of the points. The second most abundant was filamentous algae, which in 2013 was the most abundant.

Whorled water milfoil and holly-leaved naiad were recorded for the first time this year, the milfoil has been observed previously but not recorded in the point samples.

Specific species of stoneworts have decreased, fragile and bristly stonewort were not found this year.

Frogbit was observed on the broad but not recorded in the point survey. Freshwater sponges, again like at Buckenham, were attached to submerged plants.

4.5.3 Rockland

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2012	2014		
Yellow water lily	*Nuphar lutea*	*	*	1.116	21
Spiked water milfoil	*Myriophyllum spicatum*	*	*	0.274	13
Filamentous algae	*Zygnematales*	*	*	0.019	3
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.016	1
Whorled water milfoil	*Myriophyllum verticillatum*			0.016	1
Fennel-leaved pondweed	*Potamogeton pectinatus*			0.016	1
Unbranched bur-reed	*Sparganium emersum*	*	*	0.016	1
Horned pondweed	*Zannichellia palustris*			0.016	1
Starwort species	*Callitriche sp.*	*	*		
Nuttall's waterweed	*Elodea nuttallii*		*		
Common water moss	*Fontinalis antipyretica*		*		
Smooth stonewort	*Nitella flexilis*		*		
Fan-leaved water crowfoot	*Ranunculus circinatus*	*			
Water crowfoot species	*Ranunculus sp.*	*			
Total number of species recorded		**8**	**9**	**8**	**Total samples taken 62**

The number of species found at Rockland broad has been fairly consistent over the last three surveys. However, the composition of those species has changed with only five of those remaining constant. The erratic or occasional species recorded this year included; whorled water milfoil, fennel-leaved and horned pondweed, all of which were recorded in low quantities at singular points.

The most abundant species in the broad was yellow water lily located at 34 percent of the points on the broad, compared to the 16 percent in 2014

4.5.4 Strumpshaw

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2012	2013		
Filamentous algae	*Zygnematales*	*	*	8.466	30
Enteromorpha	*Enteromorpha*	*	*	0.117	17
Holly-leaved naiad	*Najas marina*		*	0.037	2
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.033	1
Inflated duckweed	*Lemna gibba*			0.003	1
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.003	1
Least duckweed	*Lemna minuta*	*			
Total number of species recorded		**6**	**5**	**6**	**Total samples taken 30**

This broad is coated in an extensive mat of filamentous algae, it was encountered at every point where a survey was attempted. Eight of the points were dropped from the survey this year because the increase in sediment level and the filamentous algae made boat access to the northern satellite pool impracticable.

Given the difficulties in surveying this broad six species were still found albeit the majority of these in very small quantities. Holly-leaved naiad, a species of note was located at two points, the hardier rigid hornwort was only found at one point. The dense mat of filamentous algae most likely outcompetes other species and shades them out.

Water-soldier was observed in one of the southern bays but not picked up in the point survey.

4.5.5 Wheatfen

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2007	2012		
Yellow water lily	*Nuphar lutea*	*	*	0.811	29
Starwort species	*Callitriche sp*	*	*	0.384	12
Unbranched bur-reed	*Sparganium emersum*	*		0.300	11
Nuttall's waterweed	*Elodea nuttallii*	*	*	0.103	12
Filamentous algae	*Zygnematales*	*	*	0.100	20
Ivy-leaved duckweed	*Lemna trisulca*			0.039	15
Horned pondweed	*Zannichellia palustris*			0.029	2
Inflated duckweed	*Lemna gibba*			0.011	6
Frogbit	*Hydrocharis morsus-ranae*	*	*	0.008	5
Common duckweed	*Lemna minor*	*		0.008	5
Intermediate water-starwort	*Callitriche stagnalis*			0.003	1
Enteromorpha	*Enteromorpha*			0.003	1
Spiked water milfoil	*Myriophyllum spicatum*			0.003	1
Amphibious bistort	*Persicaria amphibia*			0.003	1
Crowfoot species	*Ranunculus sp.*			0.003	1
Branched bur-reed	*Sparganium erectum*		*		
Rigid hornwort	*Ceratophyllum demersum*	*	*		
Fan-leaved water crowfoot	*Ranunculus circinatus*		*		
Canadian waterweed	*Elodea canadensis*		*		
Lesser pondweed	*Potamogeton pusillus*		*		
Arrowhead	*Saggitaria sagittifolia*	*			
Total number of species recorded		**9**	**10**	**15**	**Total samples taken 38**

Wheatfen differs somewhat from other broads which have been surveyed as it is a collection of connected pools instead of a large singular water body. The water clarity is very good and it has been excellent for species diversity and abundance. In 2012 when it was last surveyed 10 different species found, this year that has increased to 16, the most abundant of which is the yellow water lily. Branched bur-reed, which was the most abundant in 2012, and rigid hornwort, which is quite a widespread.

In relation to the various in data between branched bur-reed, unbranched bur-reed and arrowhead, the aquatic foliage of all three are very similar thus making it very difficult to identify.

Starworts are abundant located at 12 points scattered through the site. Three species of duckweed were recorded and appear to be plentiful as they are found at a number of points.

Marginal plants which were observed but not included in the point survey include pink water speedwell, cowbane, common water plantain and common reed.

4.5.6 Whitlingham Great

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Nuttall's waterweed	*Elodea nuttallii*	*	*	1.266	27
Flat-stalked pondweed	*Potamogeton friesii*		*	0.297	14
Common stonewort	*Chara vulgaris*	*	*	0.219	6
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.188	12
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.094	6
Fragile/Convergent stonewort	*Chara globularis/connivens*		*	0.078	5
Filamentous algae	*Zygnematales*	*	*	0.078	5
Hair-like pondweed	*Potamogeton trichoides*			0.078	5
Opposite stonewort	*Chara contraria*		*	0.047	3
Lesser pondweed	*Potamogeton pusillus*	*	*	0.047	3
Amphibious bistort	*Persicaria amphibia*	*		0.031	3
Fan-leaved water crowfoot	*Ranunculus circinatus*	*	*	0.031	2
Branched bur-reed	*Sparganium erectum*			0.031	1
Stonewort (Chara) species	*Chara sp*		*	0.016	1
Canadian waterweed	*Elodea canadensis*	*	*	0.016	1
Curled pondweed	*Potamogeton crispus*	*		0.016	1
Fennel-leaved pondweed	*Potamogeton pectinatus*			0.016	1
Fragile stonewort	*Chara globularis*		*		
Small pondweed	*Potamogeton berchtoldii*	*			
Hair-like pondweed	*Potamogeton trichoides*	*			
Unbranched bur-reed	*Sparganium emersum*	*			
Delicate stonewort	*Chara virgata*	*			
Total number of species recorded		**14**	**13**	**17**	**Total samples taken 64**

Nuttall's waterweed continues to be the most abundant species located here although its species abundance score is down as is the number of points where it was recorded. Flat-stalked pondweed is the second most abundant it has increased on last year where it was only found at one location last year.

This has been a good year for vascular plant diversity; amphibious bistort and curled pondweed have returned having not been recorded last year. Fennel-leaved pondweed and branched bur-reed are new additions to the broad having not been recorded before.

4.5.7 Whitlingham Little

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2013	2014		
Rigid hornwort	*Ceratophyllum demersum*	*	*	0.500	22
Filamentous algae	*Zygnematales*	*	*	0.432	19
Nuttall's waterweed	*Elodea nuttallii*	*	*	0.227	10
Ivy-leaved duckweed	*Lemna trisulca*	*	*	0.159	7
Fennel-leaved pondweed	*Potamogeton pectinatus*	*		0.045	2
Amphibious bistort	*Persicaria amphibia*			0.023	1
Canadian waterweed	*Elodea canadensis*	*	*		
Common duckweed	*Lemna minor*		*		
Common water moss	*Fontinalis antipyretica*		*		
Least duckweed	*Lemna minuta*		*		
Fan-leaved water crowfoot	*Ranunculus circinatus*		*		
Small stonewort	*Potamogeton berchtoldii*	*			
Unbranched bur-reed	*Sparganium emersum*	*			
Fragile/Convergent stonewort	*Chara globularis/connivens*	*			
Common stonewort	*Chara vulgaris*	*			
Total number of species recorded		**10**	**9**	**6**	**Total samples taken 44**

Annual blue-green algae outbreaks have occurred in recent years, and an attempt at treatment using floating nets filled with barley straw was attempted in spring 2015. The total number of species recorded in the survey dropped from nine last year to six this year.

Rigid hornwort can be considered to be the most abundant yet it was at a greatly reduced abundance score and found at 40% fewer points in 2015 than in the previous year. This trend in decreasing abundance is mirrored by filamentous algae and ivy-leaved duckweed results.

4.6 Waveney Valley

There are six broads along the Waveney valley which are within the Broads Authority executive area these are; Barnby, Spratt's Water, Woolner's Carr, Round Water, Flixton Decoy and Oulton Broad. The surveying of these broads was centred on monitoring the progress of the broads following restoration programmes. In 2015 Barnby broad was the only representative from this area.

4.6.1 Barnby

Common Name	Scientific Name	Present		Summary Abundance 2015	Number of samples where recorded
		2009	2012		
Rigid hornwort	*Ceratophyllum demersum*	*	*	2.768	27
Delicate stonewort	*Chara virgata*	*		2.385	22
Filamentous algae	*Zygnematales*	*	*	0.271	10
Enteromorpha	*Enteromorpha*			0.244	7
Stonewort *(Chara)* species	*Chara sp.*			0.062	2
Horned pondweed	*Zannichellia palustris*		*	0.059	2
Opposite stonewort	*Chara contraria*	*	*	0.029	1
Common stonewort	*Chara vulgaris*			0.029	1
Bristly stonewort	*Chara hispida*	*	*		
Fragile stonewort	*Chara globularis*	*	*		
White water lily	*Nymphaea alba*	*	*		
Hair-like pondweed	*Potamogeton trichoides*		*		
Convergent stonewort	*Chara connivens*		*		
Fragile/Convergent stonewort	*Chara globularis/connivens*	*			
Total number of species recorded		**8**	**9**	**8**	**Total samples taken 34**

This broad was first surveyed in 2004 and 2005 it was quite shallow and species poor, at most only having two species with the main one being rigid hornwort. It was then mud pumped in 2006/7, the survey that followed in 2009 showed a considerable increase in species diversity, eight species were found including five Chara species. In 2012 there was a shift towards vascular plants with horned pondweed and hair-like pondweed appearing.

Now in 2015 there has been a slight reduction in species richness, rigid hornwort is still the most abundant; delicate stonewort which was originally found in very small amounts in 2009 is now the second most abundant species. Filamentous algae continues to be abundant. A previously unrecorded species of Chara was found this year; common stonewort.

Common duckweed was also observed at a southern end of the broad, but not recorded in the point samples.

5 River Plant Survey

5.1 Aim

The aim of the river plant survey is similar with the Broads water plant survey, which is to monitor water plants within specified lengths of river or man-made watercourse, along previously defines sectors between early June and late July, using the methodology outlined in section 5.2 below. Ideally the river plant survey should be completed, or near enough completed, before the commencement of the broad water plant survey in July.

5.2 Survey Methodology

Following the broads water plant surveys change to a point based system, it was decided that it would be beneficial to update the river plant survey thus making it reasonably comparable with the results from the broads survey. In addition it would also be more applicable to the work which is carried out within these waterways, such as weedcutting.

5.2.1 Selection

1. The waterways surveyed need to meet a few criteria in order to be selected:
   - Foremost the section must be within the Broads executive area
   - The section must be publically navigable thus excluding private dykes or cuts
2. Once a section is chosen, it is measured using a mapping tool and the number of 10 m lengths at 5% of the total potential survey length is plotted, acquiring a representational coverage of the waterway.
3. Sectors are then plotted at each end of these 10 m lengths. A sector is a cross section of the watercourse.
4. Each sector will contain points where the sampling is conducted these range from two to five depending on the width of the watercourse.
5. An aerial photograph of each selected site was produced on which each of the sectors was marked. On the reverse of each map was a list of the grid references of each numbered sector.

5.2.2 Field method

1. In the field, surveyors used the grid references of each plotted point to identify the point's location. The survey boat navigated to each point using a handheld GPS device.
2. Once within 5 m of the plotted grid reference, a decision is made on the number of points to use within the sector.
3. Mud weights were deployed to keep the boat in the correct location at each of the cross section of points.
4. At each point, a 5 m rake throw was completed upstream and downstream. Each sample (either upstream or downstream) was recorded separately, for subsequent analysis.

5. A double headed survey rake was thrown 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 along the bed of the broad, back towards the boat. For points that were in 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.
6. On retrieval of each 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.
7. All the live plant material was identified to species level wherever possible. For example, some particularly difficult groups e.g. any non-fruiting starworts were only identified to genus level 'Starwort species'.
8. Any plant specimens where identification in the field was uncertain were collected in plastic bags, labelled using the station number reference and the direction of the throw which is the point. This is then taken for subsequent observation using a high powered microscope, or to be sent for expert identification. Wherever possible, voucher specimens were pressed and dried using standard herbarium techniques.
9. To assign a level of abundance, each species collected was given an abundance score of between 1 and 10. The score assigned should take into account the trap-ability of a particular species on the rake so that a score of 10 (91 to 100%) represents the maximum amount trappable on the rake for any particular species. As an example, a fine leaved species such as unbranched bur-reed would not be as trappable on the rake as a more structured species such as spiked water milfoil and therefore for scoring a rake pull of these species of equal volume, the score for unbranched bur-reed would be higher than for spiked water milfoil.

   As such 0.1 = <1%, 1 = 1 to 10%, 2 = 11 to 20%, 3 = 21 to 30%, 4 = 31 to 40% and so on until 10 = 91 to 100%.
10. The maximum total of all species abundance scores on an individual rake sample cannot really be more than 100%, plus or minus 10% tolerance to account for the varying trap-ability of different species

5.2.3 Data processing

1. For each sample, species abundance scores can be totalled, to produce the total abundance score for each sample. Sum of all sample abundance scores produces the site total abundance. Assuming maximum plant abundance on the site, the site abundance score should have a maximum of 10 (± 10%).
2. For data comparison, the results have been calculated to show the species richness (number of species recorded) and the species abundance scores. Species abundance is calculated by summing all the abundance scores for a particular species at each site and dividing by the number of samples, which were surveyed for that site. Within each sites results table, the species abundances have been displayed in descending order so that the most abundant species in 2015 are listed at the top of each site table.

5.3 Waxham New Cut

Waxham New Cut is a narrow dyke leading out from the north-west corner of Horsey Mere. It is a man-made channel and it runs beside Brograve Level and Brayden marshes. The length surveyed is from the dam near bridge farm to the entrance to Horsey Mere, it is approximately 2.09 kilometres long.

Common Name	Scientific Name	Summary Abundance 2015	Number of samples where recorded
Filamentous algae	*Zygnematales*	1.704	37
Water milfoil species	*Myriophyllum sp.*	0.929	36
Mare's tail	*Hippuris vulgaris*	0.791	21
Perfoliate pondweed	*Potamogeton perfoliatus*	0.125	3
Potamogeton natans	*Broad-leaved pondweed*	0.055	3
Starwort species	*Callitriche sp.*	0.038	3
Common stonewort	*Chara vulgaris*	0.038	2
Pondweed species	*Potamogeton sp.*	0.027	6
Arrowhead	*Saggitaria sagittifolia*	0.018	1
Small pondweed	*Potamogeton berchtoldii*	0.004	2
Stonewort (*Chara)* species	*Chara sp.*	0.002	1
Total number of species recorded		**11**	**Total samples taken 56**

The most abundant species within Waxham New Cut was filamentous algae, the next was water milfoil, and Mares tail is quite abundant and is prevalent along the edges of the channel.

The number of species found is relatively consistent for most of the upstream sectors. This changes on sector 7 where only one species is found, water milfoil, this then increase to three species for the following the sectors until the survey ceases at Horsey Mere.

The marginal plant common reed was observed but not included in the survey.

6 Hydroacoustic Surveys

6.1 Introduction

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, abundance, 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.

6.2 Method

6.2.1 Survey technique

The Hydroacoustic survey involves navigation a survey boat along transect routes within a broad, to provide an insight into the vegetative growth over the bed of the broad.

In 2013 the Broads Authority annual water plant survey methodology using rakes to physically collect water plants was changed from a transect based survey to a point based survey. The hydroacoustic survey was changed to incorporate the new grid based point survey thus sampling along similar grid lines to enable some level of comparison between surveys.

The equipment used in this survey included a BioSonics DT-X, single beam (10°), 420 KHz transducer, with an on-board control unit and operating laptop. All data recorded whilst mobile on the waterbody was geo-referenced through connection to an external GPS system. This allowed subsequent quantitative analysis of the data using Sonar5-Pro post-processing software, developed specifically with a vegetation analysis component.

To assist with data processing and ground truthing the bathymetric measurements, a water depth was taken at the end of each transect with a measuring staff. Notes were made about the distribution of plants within each transect.

6.2.2 Data Analysis

Using the Sonar5-Pro software, the sediment surface of each transect file was identified, as well as the less intense return derived from the upper surface of the water plants. Each transect was divided into 10 m sections for ease of analysis and to provide workable units within which to generate values for the bathymetric and water plant parameters recorded.

These were water depth (to sediment surface); plant height; area of lake bed covered by plants; and percent volume of lake inhabited by plants or PVI. Only features taller than 8 cm above the inferred sediment surface were recorded as water plants during the data processing, to reduce the likelihood of recording false positive results.

This cut-off figure was calculated by selecting a transect with negligible plant growth, and adjusting the height threshold to determine the optimal (lowest) figure that minimised false

reporting (Table 1). It was deduced that 15cm was too great a threshold to allow for fluidised sediment/non plant material, so the first threshold of 8cm was used.

Table 3 Percent plant coverage of bed, based on different height thresholds

Height threshold (m)	% of bed covered in plants
0.05	10.3
0.06	10.3
0.07	10.3
0.08	7.4
0.09	7.4
0.10	7.4
0.11	7.4
0.12	7.4
0.13	7.4
0.14	7.4
0.15	5.0

6.3 Barton Broad

Plant growth flourished in July and August 2015 following a cool spring, with observations of fennel-leaved pondweed growing up to the surface along Lime Kiln Dyke, and along the western edge of the northern part of the broad.

Figure 2 below shows the transects throughout Barton Broad in 2015, to gain a representative sample across the broad.

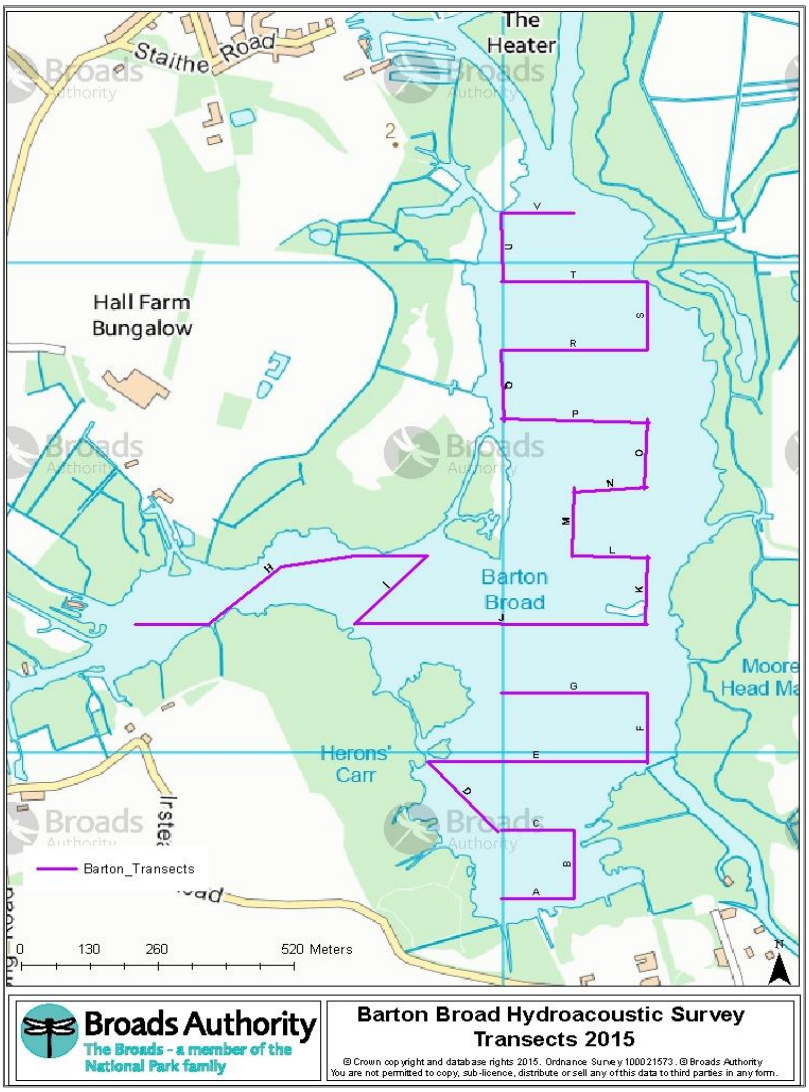

Figure 2 Barton Broad with the hydroacoustic survey transects (purple lines)

A typical screenshot of the post data processing showing transect length E is depicted in Figure 3. The black line marks the sediment surface, and the red line the height of the aquatic macrophytes. The area between the red and black lines is the % plant cover.

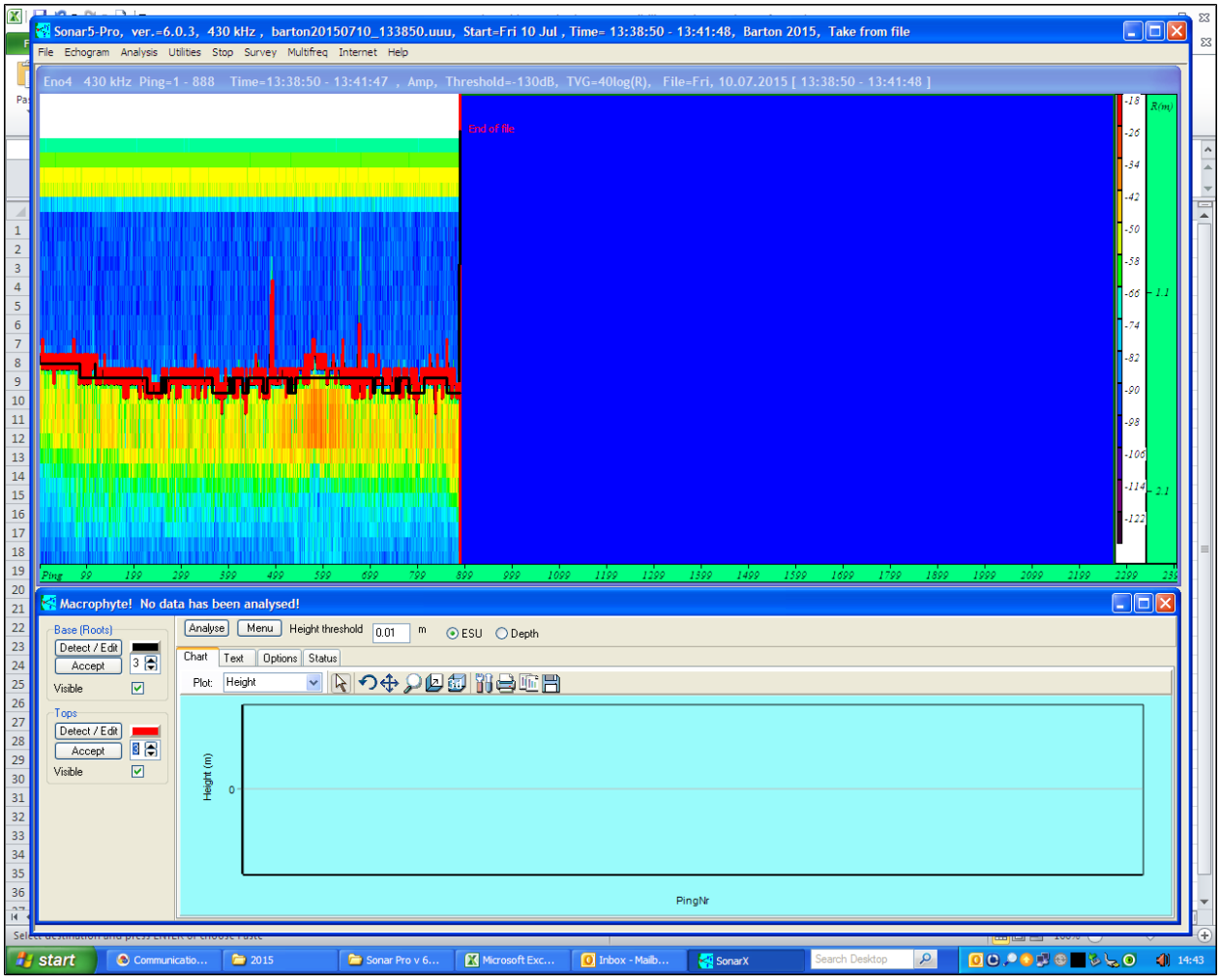

Figure 3 Typical screenshot of the processed hydroacoustic data from Barton Broad, as generated by the Sonar Pro-5 software

6.3.1 Results

In general Barton Broad had negligible plant growth throughout. Transects with the greatest volume of plants as a percentage of the water column were transects H, F and U. The average percent volume inhabited (PVI) of water plants for these transects did not exceed 15% PVI. Average PVI for remaining transects range from 0% to 7% PVI, reflecting the general lack of aquatic macrophytes.

Table 4 Hydroacoustic survey results from Barton Broad

Barton Broad	July 15
Mean water depth (m)	1.55
Max. water depth (m)	2.04
Mean plant height (m)	0.13
Max. plant height (m)	1.31
Bed covered by plants (%)	14.03
Plants as percentage of water column (PVI) (%)	3.22

Table 4 shows the average figures for the whole broad. Average water depth 1.55m with an average plant height of 0.13m. Although in contrast maximum water depth is 2.04m with a maximum plant height of 1.31m. Average PVI is 3% but plant density varied throughout the broad; total water depth totalled about 10cm lower than that recorded in the field, due to the addition of a margin needed to calculate the sediment surface.

6.3.2 Conclusion

The hydroacoustic survey has shown water plant growth in Barton Broad is relatively poor, except for parts of Neatishead Arm where plants grow to the surface. The hydroacoustic data in 2015 shows only 15% of the bed was covered in plants, with an average PVI of 3%. This general low abundance of water plants with limited distribution across the broad is also reflected in the rake based water plant survey.

6.4 Hickling

Plant growth flourished in July and August 2015 following a cool spring, with observations of water plants growing up to the surface in sheltered bays. Hickling is historically is in contrast to Barton having a plethora of different species and rich plant growth.

Figure 4 below shows the transects used in 2015 to gain a representative sample of water plant growth in Hickling Broad.

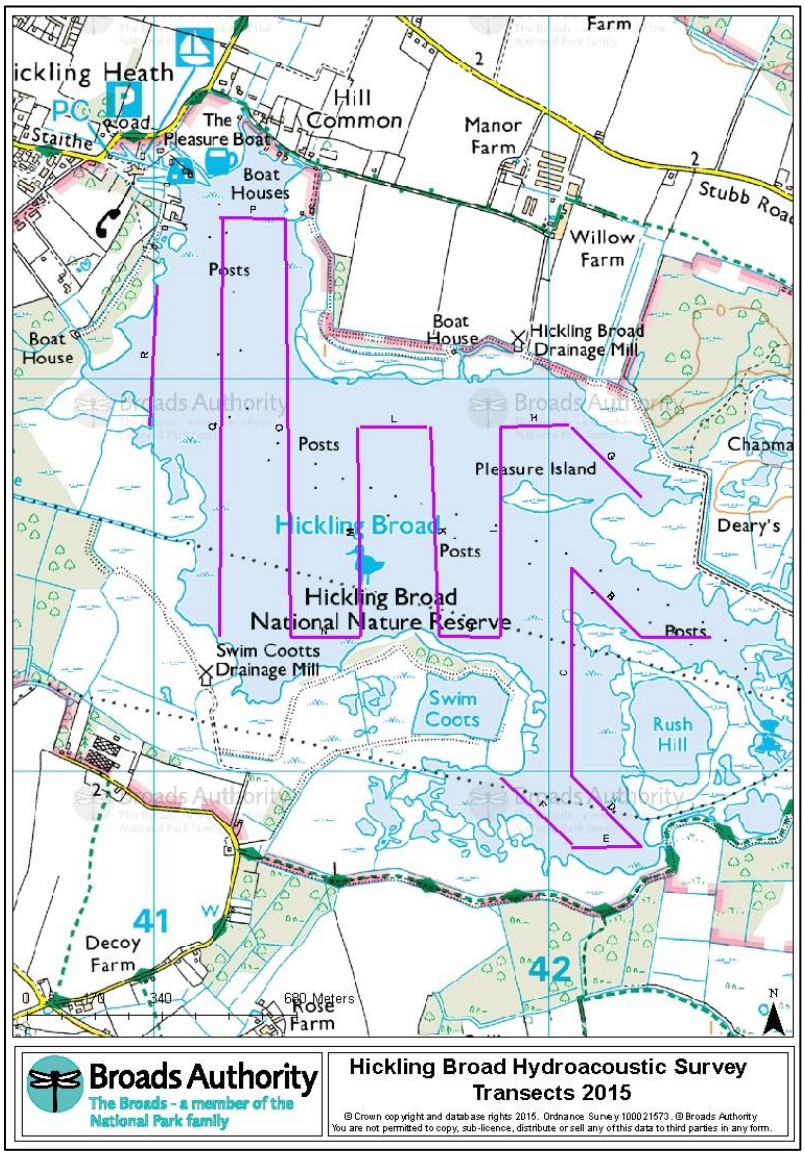

Figure 4 Hickling Broad with the hydroacoustic survey transects used in 2015 (purple lines)

A typical screenshot of the post data processing showing transect length K is depicted in Figure 5. The black line marks the sediment surface, and the red line the height of the aquatic macrophytes. The area between the red and black lines is the volume occupied by water plants.

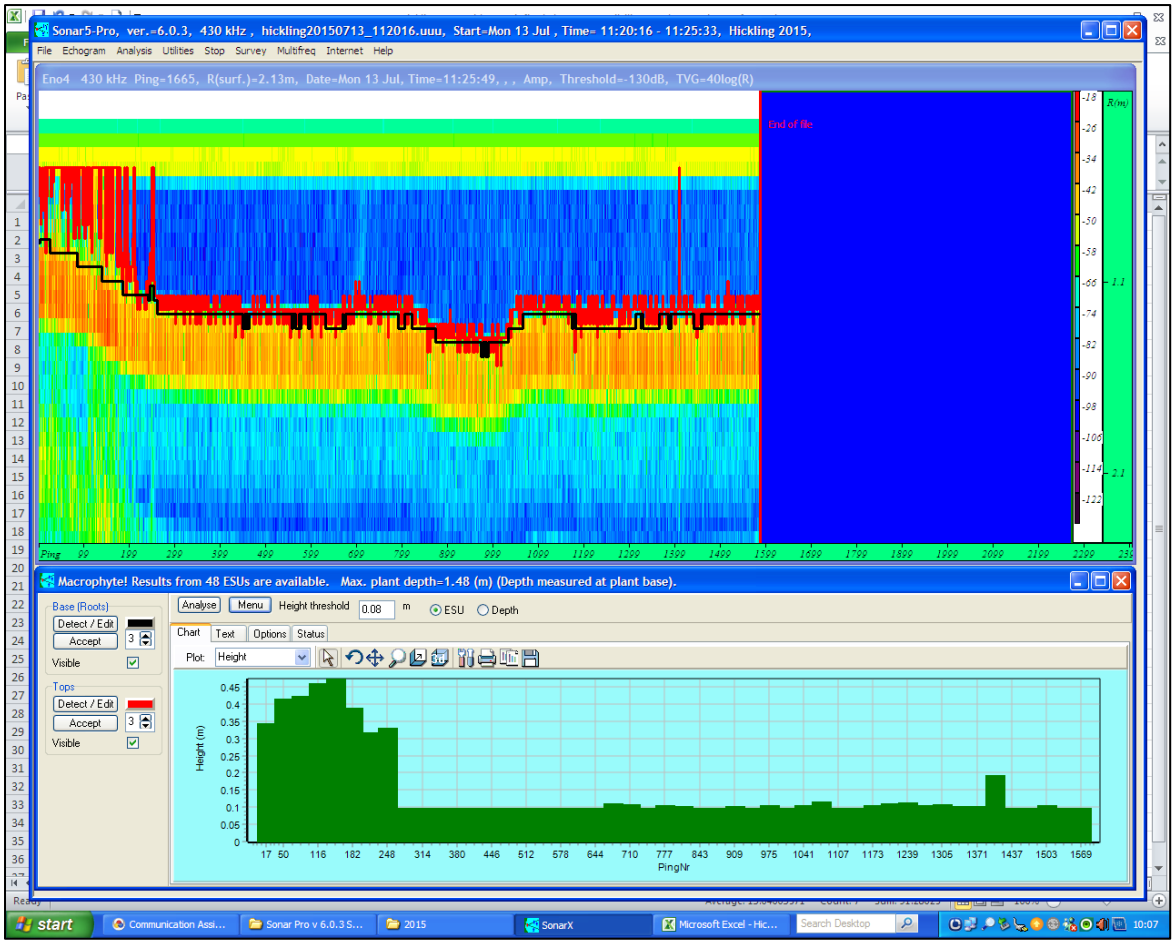

Figure 5 Typical screenshot of the processed hydroacoustic data from Hickling Broad, as generated by the Sonar Pro-5 software

6.4.1 Results

In Hickling Broad, there were a lot of plants growing in transects G, H, J, N, O and R which is reflected in a score of more than 25% PVI for each of these transects. Around the bay to the north of Pleasure Island, plants were regularly seen growing to the surface, including some large beds of bristly and intermediate stonewort. Transects G and H were particularly well vegetated with PVI recorded at over 35%. The southern and western edges of Hickling Broad were well vegetated with plants, as confirmed by the rake based water plant survey. However, the transects crossing the navigation channel, and in the middle of the broad showed the least amount of plants.

Table 5 Hydroacoustic survey results from Hickling Broad, 2015

Hickling Broad	Jul-15
Mean water depth (m)	1.06
Max. water depth (m)	1.60
Mean plant height (m)	0.24
Max. plant height (m)	1.04
Bed covered by plants (%)	34.46
Plants as percentage of water column (PVI) (%)	15.75

Table 5 shows the average figures for the whole broad. Average water depth was 1.06 m with an average plant height of 0.24 m. AltMaximum water depth was 1.60 m with a maximum plant height of 1.04 m. Average PVI was 16% but plant density varied considerably throughout the broad.

6.4.2 Conclusion

The rake based water plant survey and the hydroacoustic survey were carried out within a few days of each other in 2015, so the data collected by each technique is broadly comparable in terms of patterns in abundance and distribution. The rake based survey has shown plant growth in Hickling Broad to be increasing over the past three years. The hydroacoustic data in 2015 shows 35% of the bed covered in plants, with an average PVI of 16%.

With further development and standardisation of the hydroacoustic survey methodology and data processing next year, it is aimed to present annual trends from the data collected.

7 Acknowledgements

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Appendix 1. Macrophyte groupings based on form

Stoneworts	**Free-floating or round floating-leaved**	**Vascular Macrophytes**	
Baltic stonewort	Amphibious bistort	Arrowhead	Lesser pondweed
Bristly stonewort	Common duckweed	Australian swamp stonecrop	Lesser reedmace
Common stonewort	Frogbit	Blunt-leaved pondweed	Mare's tail
Convergent stonewort	Greater duckweed	Branched bur-reed	Nuttall's waterweed
Delicate stonewort	Inflated duckweed	Broad –leaved pondweed	Perfoliate pondweed
Fragile stonewort	Ivy-leaved duckweed	Bulrush	Reed sweet grass
Hedgehog stonewort	Least duckweed	Canadian waterweed	Rigid hornwort
Intermediate stonewort	White water lily	Common reed	Sharp-leaved pondweed
Lesser bearded stonewort	Yellow water lily	Crowfoot sp.	Shining Pondweed
Opposite stonewort		Curled pondweed	Small pondweed
Pointed stonewort		Fan-leaved water crowfoot	Spiked water milfoil
Rough stonewort	**Macro-algae and mosses**	Fennel-leaved pondweed	Starwort sp.
Starry stonewort	*Enteromorpha*	Flat-stalked pondweed	Sweet flag
Translucent stonewort	Common water moss	Floating club-rush	Unbranched bur-reed
	Filamentous algae	Greater bladderwort	Water cress
	Stringy moss	Greater reedmace	Water-soldier
	Water net	Hair like pondweed	Whorled water milfoil
		Holly-leaved naiad	Willow-leaved pondweed
		Horned pondweed	

Appendix 2a. Latin to Common plant names.

Latin	Common
Acorus calamus	Sweet flag
Alisma plantago-aquatica	Common water-plantain
Chara aculeolata	Hedgehog stonewort
Callitriche stagnalis	Intermediate water-starwort
Callitriche sp	Starwort sp.
Ceratophyllum demersum	Rigid hornwort
Chara pedunculata	Hedgehog stonewort
Chara aspera	Rough stonewort
Chara baltica	Baltic stonewort
Chara connivens	Convergent stonewort
Chara contraria	Opposite stonewort
Chara curta	Lesser bearded stonewort
Chara globularis/connivens	Fragile/convergent stonewort
Chara globularis	Fragile stonewort
Chara hispida	Bristly stonewort
Chara intermedia	Intermediate stonewort
Chara sp.	Stonewort *(Chara)* species
Chara virgata	Delicate stonewort
Chara vulgaris	Common stonewort
Crassula helmsii	Swamp stonecrop
Elodea canadensis	Canadian waterweed
Eleogiton fluitans	Floating club-rush
Elodea nuttallii	Nuttall's waterweed
Enteromorpha	*Enteromorpha*
Filamentous algae	Filamentous algae
Fontinalis antipyretica	Common water moss
Glyceria maxima	Reed sweet grass
Hippuris vulgaris	Mare's tail
Hydrocharis morsus-ranae	Frogbit
Hydrodictyon	Water net
Lemna gibba	Inflated duckweed
Lemna minor	Common duckweed
Lemna minuta	Least duckweed
Lemna trisulca	Ivy-leaved duckweed
Leptodictyum riparium	Stringy moss
Myriophyllum spicatum	Spiked water milfoil
Myriophyllum verticillatum	Whorled water milfoil

Latin	Common
Najas marina	Holly-leaved naiad
Nitella flexilis	Smooth stonewort
Nitella mucronata	Pointed stonewort
Nitellopsis obtusa	Starry stonewort
Nitella translucens	Translucent stonewort
Nitella sp.	Stonewort *(Nitella)* species
Nuphar lutea	Yellow water lily
Nymphaea alba	White water lily
Persicaria amphibia	Amphibious bistort
Potamogeton acutifolius	Sharp-leaved pondweed
Potamogeton berchtoldii	Small pondweed
Potamogeton crsipus	Curled pondweed
Potamogeton friesii	Flat-stalked pondweed
Potamogeton lucens	Shining pondweed
Potamogeton natans	Broad –leaved pondweed
Potamogeton obtusifolius	Blunt-leaved pondweed
Potamogeton pectinatus	Fennel-leaved pondweed
Potamogeton perfoliatus	Perfoliate pondweed
Potamogeton pusillus	Lesser pondweed
Potamogeton x salicifolius	Willow-leaved pondweed
Potamogeton sp.	Pondweed sp.
Potamogeton trichoides	Hair like pondweed
Phragmites australis	Common reed
Ranunculus circinatus	Fan-leaved water crowfoot
Ranunculus fluitans	River water crowfoot
Ranunculus sp.	Crowfoot sp.
Rorippa nasturtium-aquaticum	Water cress
Saggitaria sagittifolia	Arrowhead
Schoenoplectus lacustris	Bulrush
Sparganium emersum	Unbranched bur-reed
Sparganium erectum	Branched bur-reed
Spirodela polyrhiza	Greater duckweed
Stratiotes aloides	Water-soldier
Typha angustifolia	Lesser reedmace
Typha latifollia	Greater reedmace
Utricularia vulgaris	Greater bladderwort
Veronica catenata	Pink water speedwell
Zannichellia palustris	Horned pondweed

Appendix 2b. Common to Latin plant names.

Common	*Latin*
Amphibious bistort	*Persicaria amphibia*
Arrowhead	*Saggitaria sagittifolia*
ltic stonewort	*Chara baltica*
Greater bladderwort	*Utricularia vulgaris*
Blunt-leaved pondweed	*Potamogeton obtusifolius*
Branched bur-reed	*Sparganium erectum*
Bristly stonewort	*Chara hispida*
Broad –leaved pondweed	*Potamogeton natans*
Bulrush	*Schoenoplectus lacustris*
Canadian waterweed	*Elodea canadensis*
Common duckweed	*Lemna minor*
Common reed	*Phragmites australis*
Common stonewort	*Chara vulgaris*
Common water moss	*Fontinalis antipyretica*
Common water-plantain	*Alisma plantago-aquatica*
Convergent stonewort	*Chara connivens*
Crowfoot sp.	*Ranunculus sp.*
Curled pondweed	*Potamogeton crispus*
Delicate stonewort	*Chara virgata*
Enteromorpha	*Enteromorpha*
Fan-leaved water crowfoot	*Ranunculus circinatus*
Fennel-leaved pondweed	*Potamogeton pectinatus*
Filamentous algae	*Filamentous algae*
Flat-stalked pondweed	*Potamogeton friesii*
Floating club-rush	*Eleogiton fluitans*
Fragile stonewort	*Chara globularis*
Fragile/convergent stonewort	*Chara globularis/connivens*
Frogbit	*Hydrocharis morsus-ranae*
Greater duckweed	*Spirodela polyrhiza*
Greater reedmace	*Typha latifollia*
Hair like pondweed	*Potamogeton trichoides*
Hedgehog stonewort	*Chara aculeolata/pedunculata*
Holly-leaved naiad	*Najas marina*
Horned pondweed	*Zannichellia palustris*
Inflated duckweed	*Lemna gibba*
Intermediate stonewort	*Chara intermedia*
Intermediate water-starwort	*Callitriche stagnalis*

Common	*Latin*
Ivy-leaved duckweed	*Lemna trisulca*
Least duckweed	*Lemna minuta*
Lesser bearded stonewort	*Chara curta*
Lesser pondweed	*Potamogeton pusillus*
Lesser reedmace	*Typha angustifolia*
Mare's tail	*Hippuris vulgaris*
Nuttall's waterweed	*Elodea nuttallii*
Opposite stonewort	*Chara contraria*
Perfoliate pondweed	*Potamogeton perfoliatus*
Pink water speedwell	*Veronica catenata*
Pointed stonewort	*Nitella mucronata*
Pondweed sp.	*Potamogeton sp.*
Reed sweet grass	*Glyceria maxima*
Rigid hornwort	*Ceratophyllum demersum*
River water crowfoot	*Ranunculus fluitans*
Rough stonewort	*Chara aspera*
Sharp-leaved pondweed	*Potamogeton acutifolius*
Shining pondweed	*Potamogeton lucens*
Small pondweed	*Potamogeton berchtoldii*
Smooth stonewort	*Nitella flexilis*
Spiked water milfoil	*Myriophyllum spicatum*
Starry stonewort	*Nitellopsis obtusa*
Starwort sp.	*Callitriche sp*
Stonewort *(Chara)* species	*Chara sp.*
Stonewort *(Nitella)* species	*Nitella sp.*
Stringy moss	*Leptodictyum riparium*
Swamp stonecrop	*Crassula helmsii*
Sweet flag	*Acorus calamus*
Translucent stonewort	*Nitella translucens*
Unbranched bur-reed	*Sparganium emersum*
Water cress	*Rorippa nasturtium-aquaticum*
Water net	*Hydrodictyon*
Water-soldier	*Stratiotes aloides*
White water lily	*Nymphaea alba*
Whorled water milfoil	*Myriophyllum verticillatum*
Willow-leaved pondweed	*Potamogeton x salicifolius*
Yellow water lily	*Nuphar lutea*