

2020



Fishery Plan for Steeple Langford Lakes

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SALISBURY AND DISTRICT ANGLING CLUB

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References:

Fish Kill Review: Steeple Langford 2016 dated Jan 2019, Author Dom Longley BSc (Hons)

Barley Straw Protocol for Salisbury and District Angling Club Lakes, Author Paul Clancy

SADAC Still water coarse fishery water quality monitoring:
January & February results Dom Longley BSc (Hons), 7th March 2020

English Heritage Landscape Advice Note: Canada Geese 2014; Product code:51922

Environment Agency Guide to Stocking for Fishery Owners and Angler

Institute of Fisheries Management guide: Creation and management of still water coarse fisheries:

Introduction

Steeple Langford lakes have been a part of the Salisbury and District fisheries portfolio for the last 70 years. In response to fish kills that took place in 2016 and 2020 this 5-year plan has been created in order to try and alleviate further problems. This document will go into some of the details of the fish kills which can be found in the Fish Kill Review: Steeple Langford, 2016, dated January 2019, written by Dom Longley BSc (Hons).

The long-term aspirational plan for the two lakes is as follows:

The Pleasure Lake is to become a mixed fishery for all abilities to be able to catch fish of all sizes. However, due to the lakes issues in the past there would have to be a more balanced stock erring to the side of non benthivorous species of fish such as Rudd, Tench and Crucians and far less Carp or Bream.

White Bird Lake due to its history and it being our largest club coarse lake will be set to remain our premier specimen water, again, due to the water quality issues the stock levels will have to be managed very carefully but the aim would be to have fewer, more sought after, special fish of a multitude of species. It will remain a difficult water.

Description of water

General

Steeple Langford lakes can be found to The south of Salisbury Plain, alongside the A36, 3Km south east of the intersection with the A303 and approximately 14Km west of Salisbury City Centre in the heart of the Wylde Valley, see fig 1. There are several lakes in the area as part of Steeple Langford Nature reserve, but we are only interested in the northern two lakes, White Bird and Pleasure. They cover an area of approximately 15 acres, are interconnected, fed by groundwater from a spring and they flow back into the River Wylde that runs alongside, with barely 3m of separation in places, see fig 2. The lakes are old gravel workings, they were dug in around the 1950's to 1960's for the gravel to help towards the building of local roads, they were originally 3 lakes, but later the two westerly lakes were merged into one and the lakes have become a coarse fishery. The lakes are owned by the Snook family, of which one member lives on the site with a small flock of sheep. Salisbury and District Angling Club own the fishing rights and a small area to the north of the Pleasure Lake for parking, they also have access rights granted along a gravelled track running south from the A36.

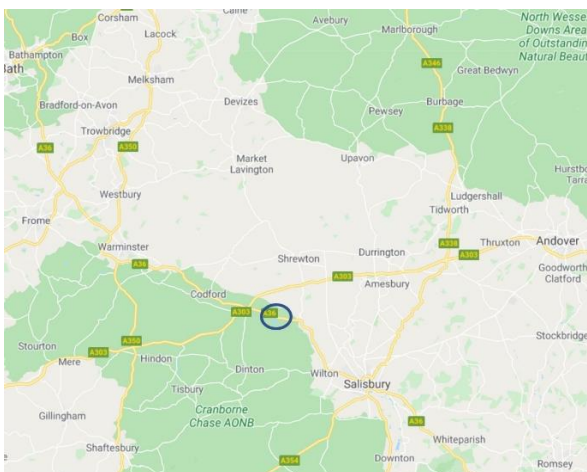


Figure 1 Langford Lakes Location General



Figure 2 Steeple Langford Lakes location in detail

White Bird Lake

Approximately 9.52 acres with depths averaging around 1.2m, roughly rectangular, 320m X 100m, in shape running along the Wylle Valley. The Eastern end is the deepest water with depths to approximately 1.8m, the shallower western end averages 0.9m in depth. There is a small island in the north east corner and the south west corner of the lake leads into a back bay behind a thin spit, this area is very shallow and surrounded by trees. The lake bed is made up of gravel bars and silt with a few clay areas in the margins, some of the gravel bars are very pronounced and come to within 0.6m of the surface when the water level is low in the summer.

There are 30 swims surrounding the lake, all but one may be night fished. The day only swim is on the west bank in the reeds on a 20m long boardwalk and platform. Several of the swims have been refurbished in recent years but there is no significant requirement now for further improvements. In 2019 a double gate replaced a stile on the south bank, and this has increased accessibility to the swims in that area.

Several of the swims on the north bank are close to the perimeter fence and this restricts their use for casting and the use of bivvies and angling shelters.

It is believed that there is a spring in the south west corner of this lake which is the source of the groundwater that flows through the lakes before passing through the adjoining Pleasure Lake and ultimately flowing into the River Wylle.



Figure 3 White Bird Lake

Pleasure Lake

The smaller of the two lakes approximately 2.42 acres in size, again roughly rectangular 160m long by 60m across, there are several islands in the western third of the lake and these split the lake into two main areas. It has an even depth of approximately 1.2m and the lake bed is made up of silt, gravel and sand with clay in some marginal areas. Currently there are 17 swims around the lake, these range from gaps in bushes to purpose made platforms. This lake is very close, about 3m in places, to the Wylfe and in times of high water many areas around the lake become flooded, the south bank in particular is susceptible to erosion due to flooding.

The lake had been surrounded by trees until 2019 when the first stage of fishery improvements was to open the lake to the wind by removing a lot of the trees from around the lake's banks. This also involved clearing a lot of the marginal snags and trees from on the islands.



Figure 4 Pleasure Lake

Stocking levels

As this is being written in June 2020, we are beginning the recovery process from the lakes second major fish kill in the last 4 years. The stocking levels in both lakes are unknown as they have not been successfully measured in recent history, however, several stockings have taken place in the last 4 years.

- 5th October 2017: 80 x 1.25lb Tench stocked to White Bird Lake, sourced from Heather Fisheries.
- 9th Nov 2017: thousands of carp fry cropped from Redlynch (Heather Fisheries) stocked to Pleasure Lake.
- 5th Dec 2017: 500lb Roach, Bream & Perch cropped from Gasper Lake (Heather Fisheries) stocked to Pleasure Lake.

It is unknown how many of these fish have survived as the lakes have been suffering badly from predation during the winter months, mostly from Cormorants with upwards of 20 visits a day.

An attempt at netting the Pleasure Lake was undertaken in the winter of 2018 but could not be considered a success. Two Pike and a handful of Rudd, Tench and Perch to 4 inches in length were found and the netting itself was difficult due to the number of snags found in and around the lakes margins.

Current Status of lakes:

White Bird Lake:

This lake is reeling from the second major fish kill in the last 4 years, 2016 and 2020. Over 5 weeks in March- April 2020, the following were removed from the lake:

- 47 Bream to 9lb 12oz average weight of around 6lb
- 45 Carp up to 38lb 8oz, average size of approximately 20lb
- 12 Pike up to 8lb
- 10 Tench up to 7lb 4oz
- 20 + small Roach, Rudd, Eels and Perch



	Pleasure	White Bird	Both	Est Mean lb	Est Total weight
Carp	1	44	45	20	900
Bream	1	46	47	6	282
Tench		10	10	4.5	45
Pike	6	6	12	4	48
Other	10	10	20	0.3	6
Estimated Biomass Lb					1281
Estimated Biomass Kg					582.27

Table 1 : Details of retrieved fish 2020

Table 1 shows the estimated weight of the biomass retrieved during the fish kill in March – April 2020, if we remove the biomass lost from the Pleasure Lake we end up with a figure of approximately 1228lb or 558Kg.

There is an extremely high probability that this was caused by an algal bloom that had been manifesting for 4 weeks prior to the fish kill. Investigations in the past have shown that the Algal blooms that occur in Steeple Langford Lakes are particularly severe and this can be seen in the form of the blue-green algae that saw the fishery closed for an extra 6 weeks during June and July of 2019.

The predominant type of angling at this venue is for specimen carp using ledgering tactics. Fishing overall throughout the 19/20 season was poor with most anglers struggling for bites, although there were two windows of good sport in September and in late February.

The north bank was put out of bounds during the latter part of the 19/20 season due to excessive rainfall, which made the bank extremely boggy in places and the ground became damaged and scarred. The south bank also did not fare much better and passing through the double gate was treacherous at times with knee deep water.

Pleasure Lake:

This lake took the brunt of the 2016 fish kill with 28 carp recovered up to 36lb in weight and several other species suffered numbers of casualties, the full details can be found in the Fish Kill Review: Steeple Langford 2016 document.

Due to the hard reputation of this lake and few sightings of fish, this lake receives very little angling pressure, usually in the form of specimen carp anglers and pike anglers lure fishing, however, some good nets of Rudd were caught in the summer of 2019 from the causeway. Very few other fish were reported, possibly 3 Carp and a handful of Jack Pike all season.

The lake is connected to White Bird Lake by a narrow channel in the causeway, and it suffers from all of the same water quality issues as its neighbour, aquatic weed has proliferated in recent seasons making angling challenging at times. The high-water levels in December to March 2020, again saw the Wylve flowing over the South bank which meant on the north bank several areas were not passable without the use of waders due to the water depth.

Known Problems:

Water Quality: In recent history there have been several events at Steeple Langford lakes that have provided indications of poor water quality, these normally present themselves in the form of algal blooms and fish kills. This poor water quality seems to start from the source, the ground water spring comes from the aquifer that fails the Water Framework Directives standard for elevated nutrients. This is then further compounded by the amount of sediment that has started to build up in the lakes over the last 75 years as can be seen in Annex A the Steeple Langford Silt Survey, we will look at the silt issue in more detail later. All of the water measurements that have been taken in 2016 after the first fish kill and in early 2020 when the new program started have shown one thing in common, there are high levels of nitrites, ammonium and nitrates. All of these affect the pH of the water, oxygen levels and many other factors that dictate the health of the environment over the long term. More information can be found in the referenced documents.

Algae: Due to the water quality issues highlighted above, the whole environment of the lakes is a eutrophic one, this has been seen many times but none more strikingly than the blue-green algae blooms of April to July 2019, that saw the fishery closed for an extra 6 weeks of the 19/20 season. This was confirmed as a toxic blue-green algae by letter ref 01693319 from the Environment Agency on the 10th April 2019. The letter stated:

'I would like to confirm that the sample taken on 9 April 2019 from Pleasure Lake (SU 04223 37108) had a bloom of toxic blue-green algae (cyanobacteria). Specifically, a matrix of diatoms, green algae Spirogyra and blue-green algae Oscillatoria sp. were found in the scum/mat formation.'

The letter also gave best practice on how to deal with a blue green algae bloom in the form of a leaflet that stated not to allow people or livestock in or near the water due to the toxic nature of the algae. The algae also forms blanket or Silt weed across a lot of the bottom of the lakes, and other typical blooms are when the algae floats to the top which usually happen in the spring around Mid-March until May.



Figure 5 A typical wind affected bloom west bank of White Bird Lake

Silt: After the Petersfinger lakes fish kill in March 2019 the club started to investigate the extent of the silt problem in our lakes, this has formed the basis of Annex A: Steeple Langford Silt survey. This document shows the extent of the issue in that there is a clear build up of silt across both lakes, this shows that approximately 30% of the lakes volume is silt. In December 2019 an analysis of the silt content was made, the full results can be seen in the Steeple Langford Fish Review Document, which showed that the overall

organic content of the silt is quite high. This high level of organic matter means that silt treatments such as Siltex should have an effect on the silt in the lakes, but more investigation would be needed to enable more drastic silt reduction techniques to be selected in the future.



Figure 6 Silt analysis at Steeple Langford Lakes

Birds: Although not all bird life is detrimental to the ecology of a water body, there are exceptions and Steeple Langford lakes due to their close proximity to a nature reserve see an increased number of Canada Geese on an annual basis, numbers can range from 30-200 and the nutrient input to the lakes is considerable. There can also be large numbers of Mute Swans, if a dominant pair is not established in the early spring there have been up to 30 birds in addition to the Canada Geese. The damage caused by these birds is not restricted to under the waters surface as the areas where they roost on land will start to look like scorched earth after a short period of time. This reduces the number of useable swims, adds to nutrient levels, affects the landowners grazing and is generally unsightly.



Figure 7 Two examples of Bird damage to the banks

Water levels: The water levels of these lakes are influenced directly by the levels of the River Wylfe that runs alongside the lakes, this with the fact that the lakes are fed from groundwater from the Wylfe catchment means that the levels do not tend to drop too low, but the lakes are susceptible to flooding during periods of high river levels. The main areas that suffer can be seen in the Diagrams below:

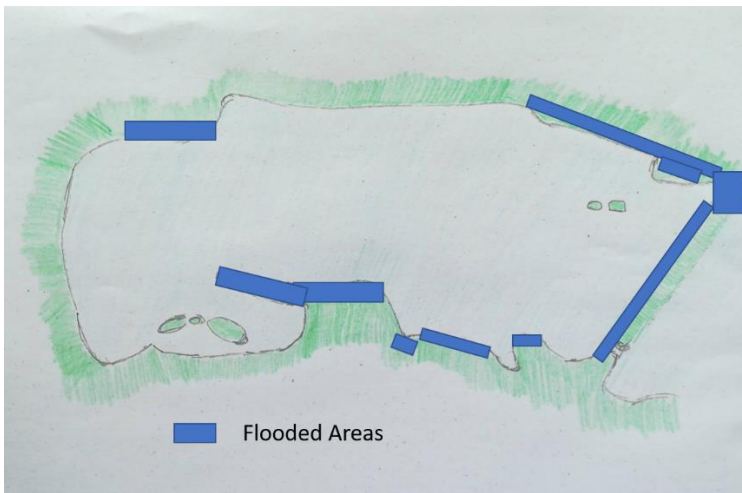


Figure 8 White Bird Lake Flooding 2019



Figure 9 Pleasure Lake Flooding 2019

There was a significant amount of water running directly from the River Wylfe into the Pleasure Lake during the winter of 2019, due to the height, there was also approximately 30cm of water across parts of the causeway between the lakes and also near the outflow leaving the lakes. This flood water will have flushed organic material and silt into the lakes rather than flushing the lakes out as is often believed. Combined with the rapidly dropping water levels, rising spring temperatures and evaporation this then concentrates the organic material, leading to problems.

Predation: The lakes are generally quite clear throughout most of the winter months and are therefore very susceptible to predation from Cormorants and other fish-eating birds. Upwards of 20 visits a day have been witnessed when the Cormorants are at their most prolific, various methods of deterring the birds has been employed up until now including mannequins and licenced culling. Due to the numbers of the inland cormorants at times the deterrents seem to have little effect on the numbers of birds on the water at certain times of year, especially as they are encouraged on the nature reserve next door.

Otters are another predator that are often seen on the lakes, in previous years up to 20 Carp have been predated by otters but in 2019 the numbers were greatly reduced on all species of remains found. Spraint can be found in certain areas around both lakes and there are usually signs of small pike and eels in the remains, and a resurgence of eels in White Bird Lake could explain the reduction in fatalities of other species.

Plans

For the club to achieve our goals of turning the waters back into fully sustainable coarse fisheries for years to come we need to enact a robust and comprehensive plan. Please note that timelines for works are dependent on funding for the projects that comes from membership monies and outside grants.

Creation of a fishery management plan – This document, the fishery plan will be reviewed constantly, and updated whenever there is a significant change to reflect the new working environment.

Monthly water testing - Monthly water monitoring programme to be established and maintained as per SADAC Stillwater coarse fishery water quality monitoring documents by Dom Longley BSc (Hons). These were restarted in late May 2020 for both lakes and will be published biannually.

Annual mark and recapture stock assessment- This will be carried annually out as per the netting plans for both lakes (Annex's C and D) to ensure that we have a representative idea of the stock of both lakes as this will allow us to make informed decisions in the future. The results of any netting operation will be published in due course.

Stock maintenance and balancing- This will be carried out concurrently with the stock assessments, the aim is that we will be able to maintain healthy stock densities in both lakes. During netting procedures Carp caught within the Pleasure Lake over 4.5Kg will be moved into White Bird, and the reciprocal will be the same for any carp under 3Kg from White Bird into the Pleasure Lake. This would also allow us to use the Pleasure Lake as a growing on pond for small numbers of Carp so that once large enough they can be moved into White Bird Lake, but never at the detriment of other fish species. This balancing may also involve the cropping of smaller fish from both lakes to other destinations, in order to maintain the healthy stock densities as laid down by the Environment Agency in their 'Stocking Fish for fishery owners and anglers guide Dated 2000'. This states a healthy stock density for an established gravel pit is 250 Kg/ha (223lb/Acre).

Installation of solar panelled aerators- To assist with reducing the effects of the eutrophic environment within the lakes it is recommended that we fit aerators, the obvious positions are the islands in both lakes but due to the lack of mains electricity at the site the aerators will have to be solar powered. This will also allow the club to move the aerators around the lakes more easily to where they are needed the most, this information will be gathered during the water quality tests.

Creation of fish refuges- One of the methods to reduce the number of nutrients entering the lake is to remove a lot of the surrounding trees and overhanging foliage. We are installing effective fish refuges to protect the lakes stock from predation. These are in the form of floating islands, the design is a frame of plastic pipe, filled with plastic bottles to compartmentalise the frame in case of damage. The base of the island is Coir matting supported by stock mesh to prevent the platform from sagging. In the initial deployment phase these are being floated to provide shade and overhead cover for the fish, after the first stock nettings in the winter of 2020 gabion mesh will be placed into the full depth of water around the floating islands and this will then be filled with brash to provide protection for smaller fish from Cormorants when they are most at risk.

Predator deterrents in the form of mannequins have also been mounted around the lakes to try and deter airborne predators, these need constant movement and maintenance to ensure their effectiveness.

Implementation of barley straw- To try and reduce the number and severity of algal blooms the club will be using barley straw; this is explained fully in Annex B the Salisbury and District Angling Club Barley Straw Protocol.

Reduction of Nutrient Inputs- As explained earlier in this document Steeple Langford lakes suffer from excessive nutrients in the water that then causes an eutrophic environment. Some of these inputs have already been looked at, for the Pleasure Lake for instance many of the surrounding trees have been

removed to allow water movement from wind and also to reduce the amount of leaf litter entering the lake, but , this is just the tip of the iceberg. The influence from bird life needs to be reduced, the Canada Geese are especially detrimental to these lakes so means of reducing the appeal to the birds need to be implemented. This will be achieved by introducing marginal plants and temporary obstructions in swims to restrict the bird's access to land as per the English Heritage Landscape Advice Note: Canada Geese 2014; Product code:51922. The plants in themselves will assist with the nutrient levels in the lake, however, the currently present aquatic oxygenators Milfoil and Canadian pondweed will often grow out of hand and may need mechanical removal from the lakes, if this takes place and the weed is composted away from the lakes it can be a good way to reduce the nutrients in the water and therefore reduce the number of algal blooms.

Silt Removal- This is a very challenging subject, however, due to the sheer quantities of silt involved this would be no easy task but it needs to be addressed in the future to ensure the lakes survival. In a number of Sub-committee meetings we believe that in the short to medium term, we have enough evidence that Siltex application will be beneficial, even though this is a naturally alkaline lake - this is because the thick sediment has a lower pH and is resistant to the pH raising effect of water alone (sub surface aeration / circulation helps). Siltex delivers calcium carbonate directly to the silt surface. However, the action of Siltex does release nutrient compounds from sediment, so while it has an overall beneficial effect and addresses the root cause, it means water quality will inevitably improve only slowly and for several years at least, there will be dynamic algal activity - there's no way around that.

Disabled access and disabled platform/swim- It is the aim to have two access platforms for the disabled on the north bank of the Pleasure Lake as there is easy access from the car park and facilities from that area. It will entail the laying of a suitable path and then the creation of a suitable platform in both locations.

General maintenance-

Access road maintenance

General gate and fence maintenance when required (annual appraisal)

Annual repair and maintenance of platforms

Tree work when required

By utilising AGILE project management, i.e. breaking the goals into smaller more easily achievable goals, whilst conducting this work the club will be able to move forward taking small bites out of the larger project for the maximum benefit for the future.

Works already started/completed June 2020-

Fishery management plan written

Monthly water monitoring in progress

First silt assessment

Netting plans for both lakes written including risk assessments

Barley straw protocol written

Floating islands onto Pleasure Lake

Regular Canada Geese and predatory bird deterring

Gate and fence maintenance

Pleasure Lake tree and snag removal

Conclusion

The two lakes have suffered in recent history, due to poor water quality. We now have a good idea as to the causes and how best to go about trying to reduce the effects on the lakes. It is important to understand that there will be no returning to the halcyon days as the lakes have evolved, changed and not for the better in regards the environment that they provide. So we need to start to become used to a new way of managing the lakes and a new fishery in reality, we can use the catchphrase of the moment and finding the 'new normal' for the lakes themselves. Now it is down to us, the clubs committee, keepers and members to take this situation and make something for the future, yes it will be a long, hard struggle and there will be many times when it will be easier to give up rather than do it the right way. There will be a considerable financial burden attached to this plan, not just with purchases but also with man hours, that will need to be balanced and calculated, but with clever planning we should be able to work together to reduce the overall costs with a satisfactory outcome.

This is our first formal 5-year plan for this fishery and as we say in the military, "No plan survives first contact!" So, there may very well be changes in the short term to help work towards the delivery of the long-term goals and we can but hope that all this work will start to see benefits before we write the next 5-year plan in 2025.

Finally, remember we are striving to make these lakes the places that future generations will be able to remember as fondly as we do today.

Annex A:

Steeple Langford silt survey results

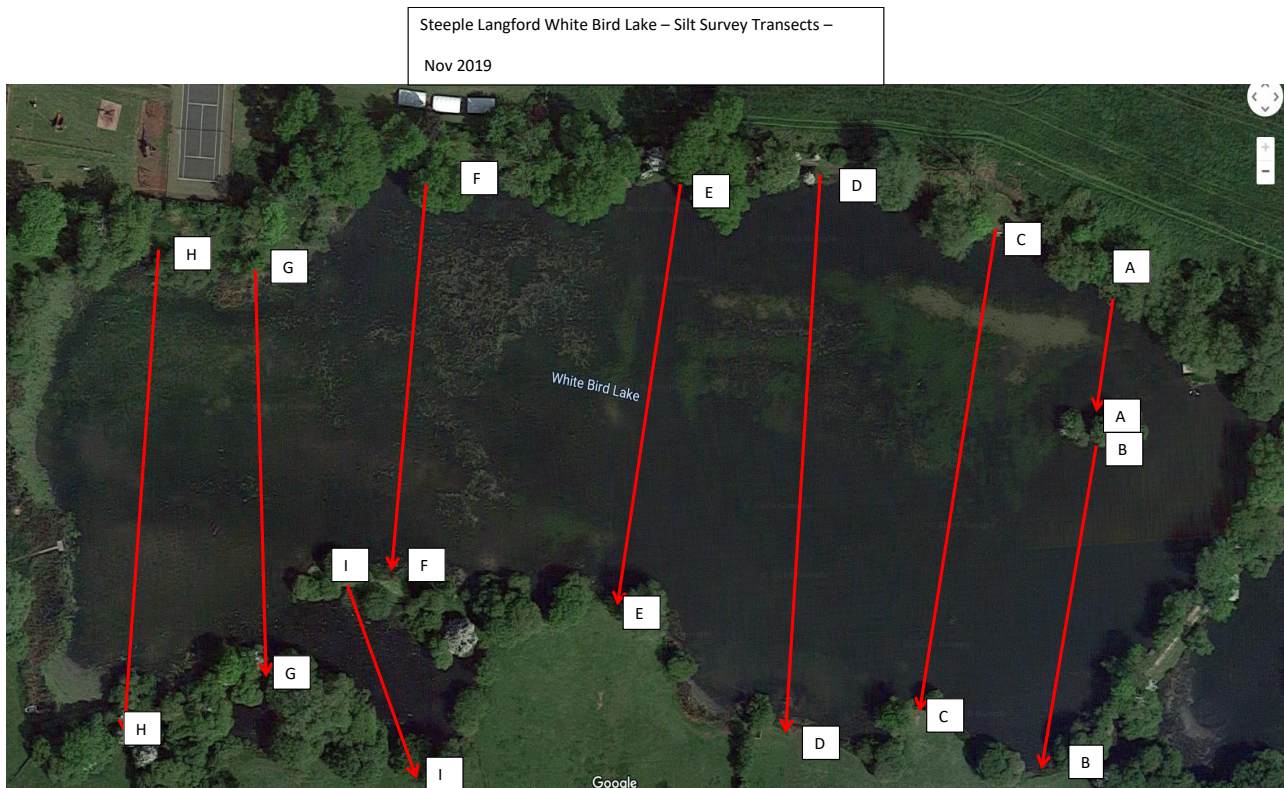
Conducted by Paul Clancy BSc (SADAC River Keeper) and Robert Badlam (SADAC Committee)

In November 2019 a team from the Salisbury and District Angling club embarked on a silt measuring project across both the lakes on the Steeple Langford site. This is a brief overview of the method and results.

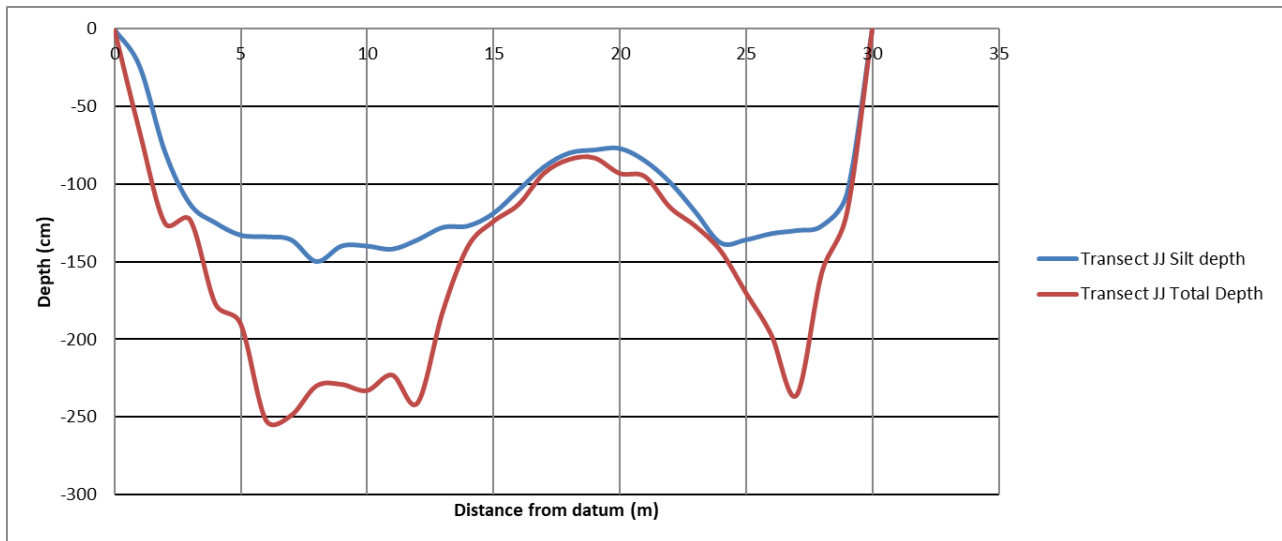
Method:

A measured line was set across the lake marked at regular intervals, at each of these intervals a measurement was taken using a depth pole with a sharp end to reach down to the lake bed and a large flat end to settle on the top of the silt. These poles were marked so that the depth from the surface to the substrate could be measured.

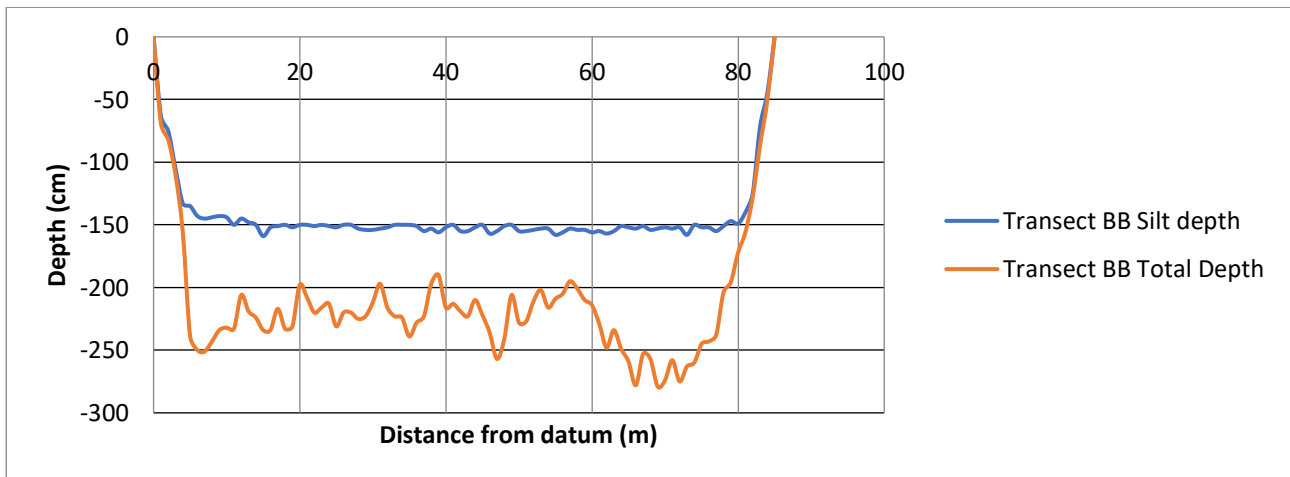
Below the diagrams show the transects taken for firstly White Bird Lake and then Pleasure Lake. The graphs then show both the silt and lakebed depths, for each lake, and the comparison between, finally the table shows all the data collected.



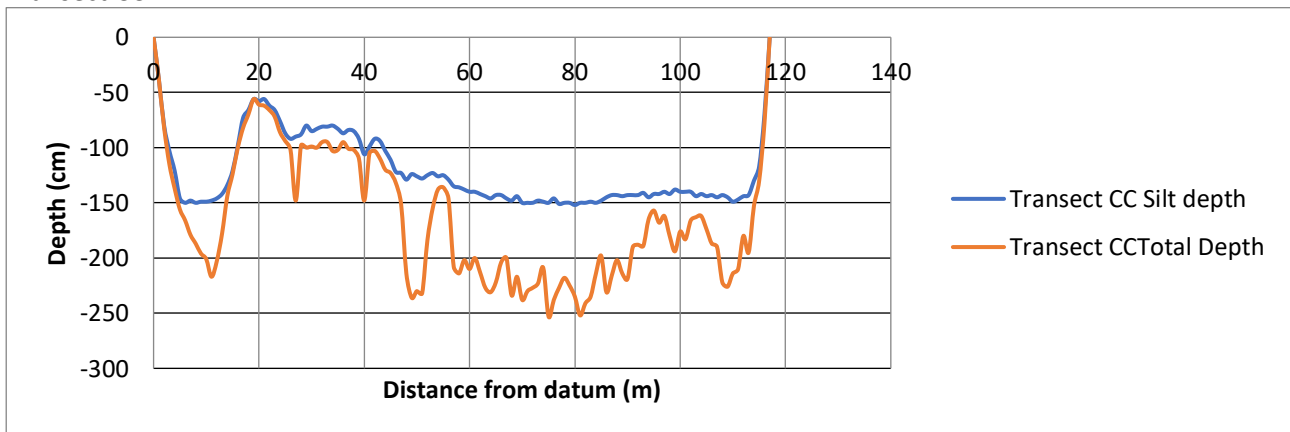
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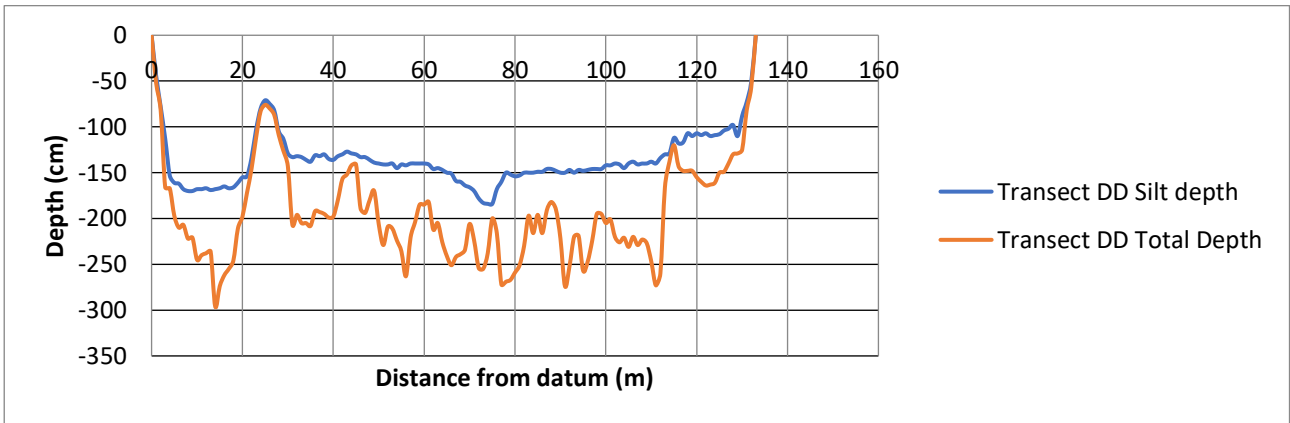
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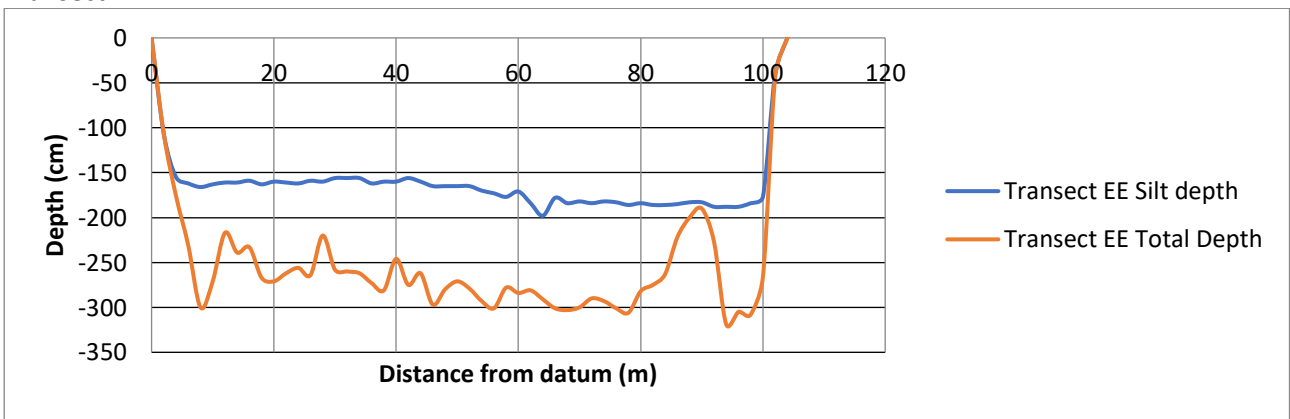
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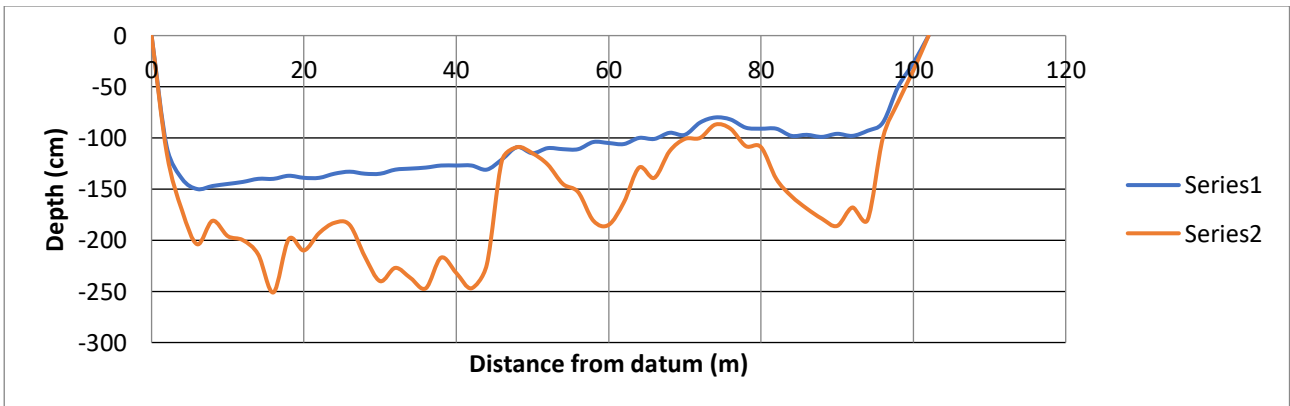
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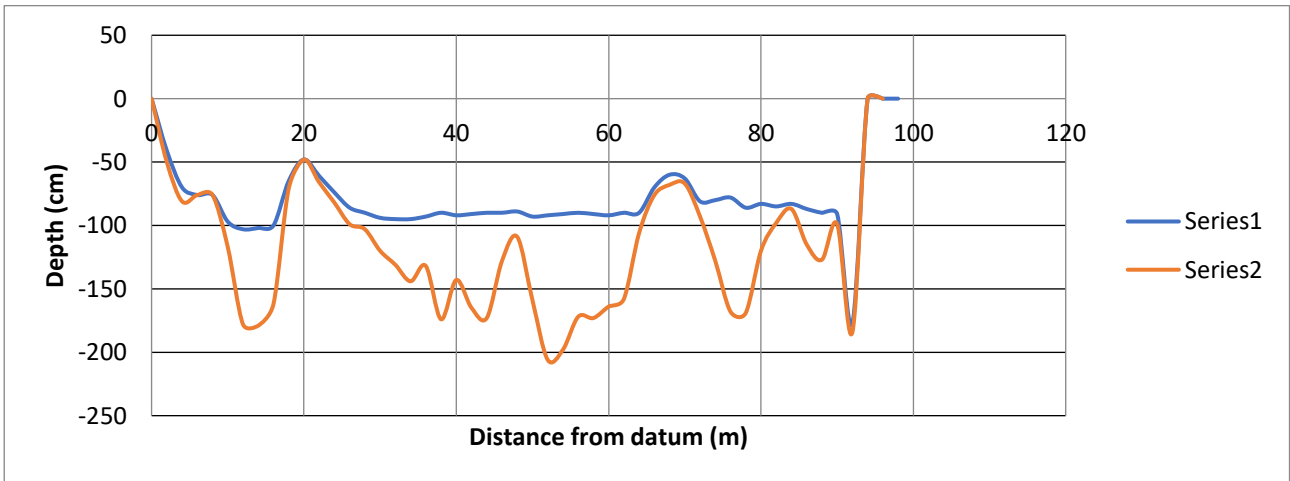
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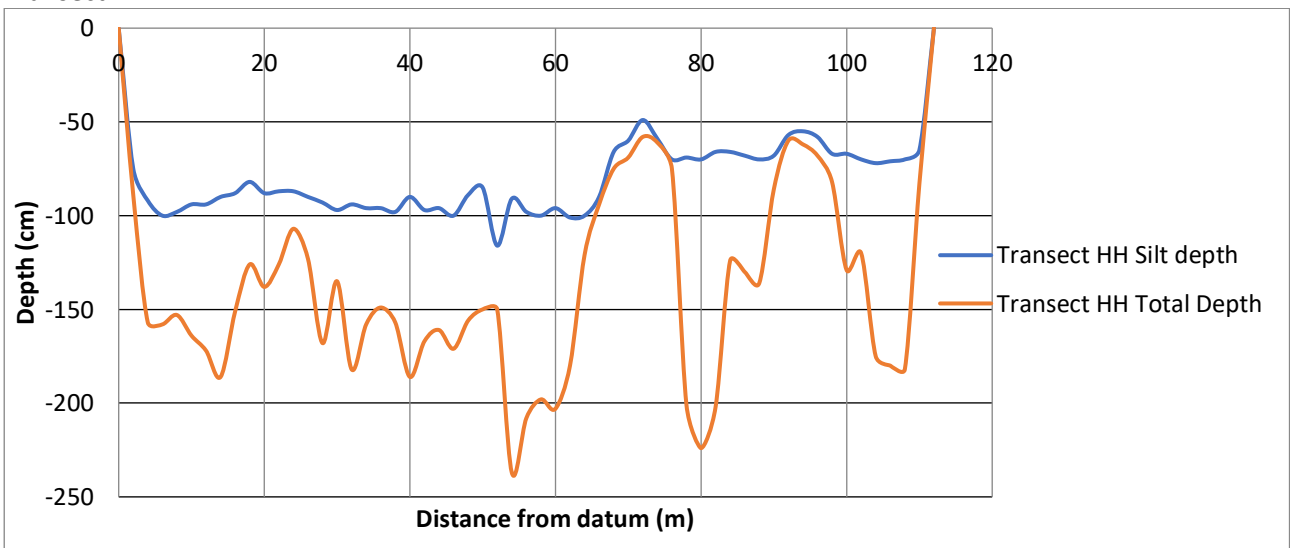
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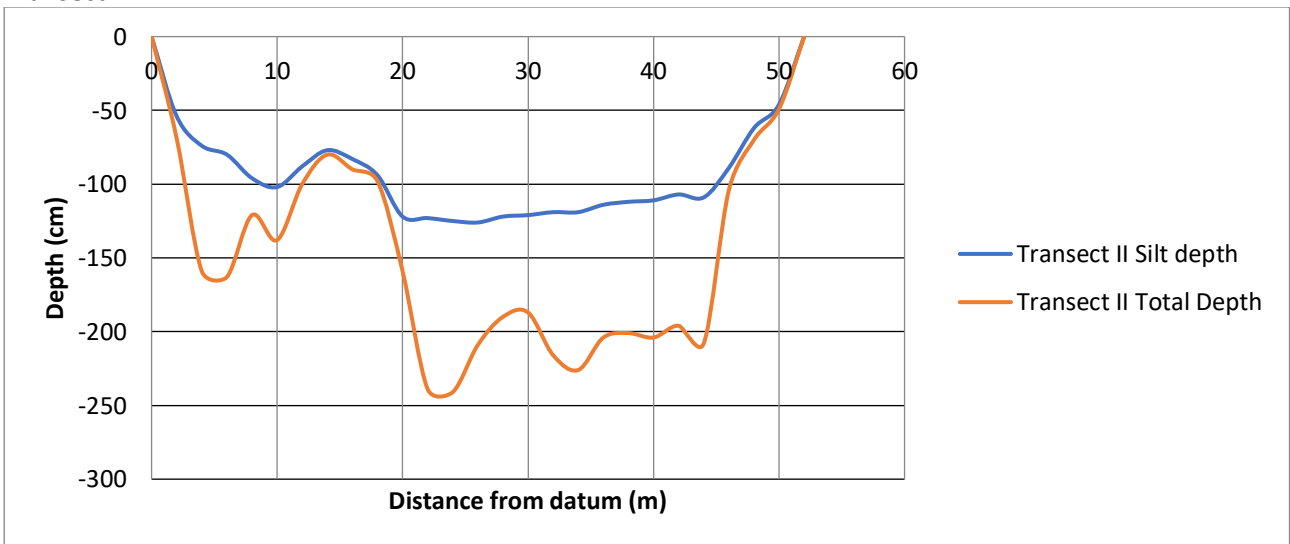
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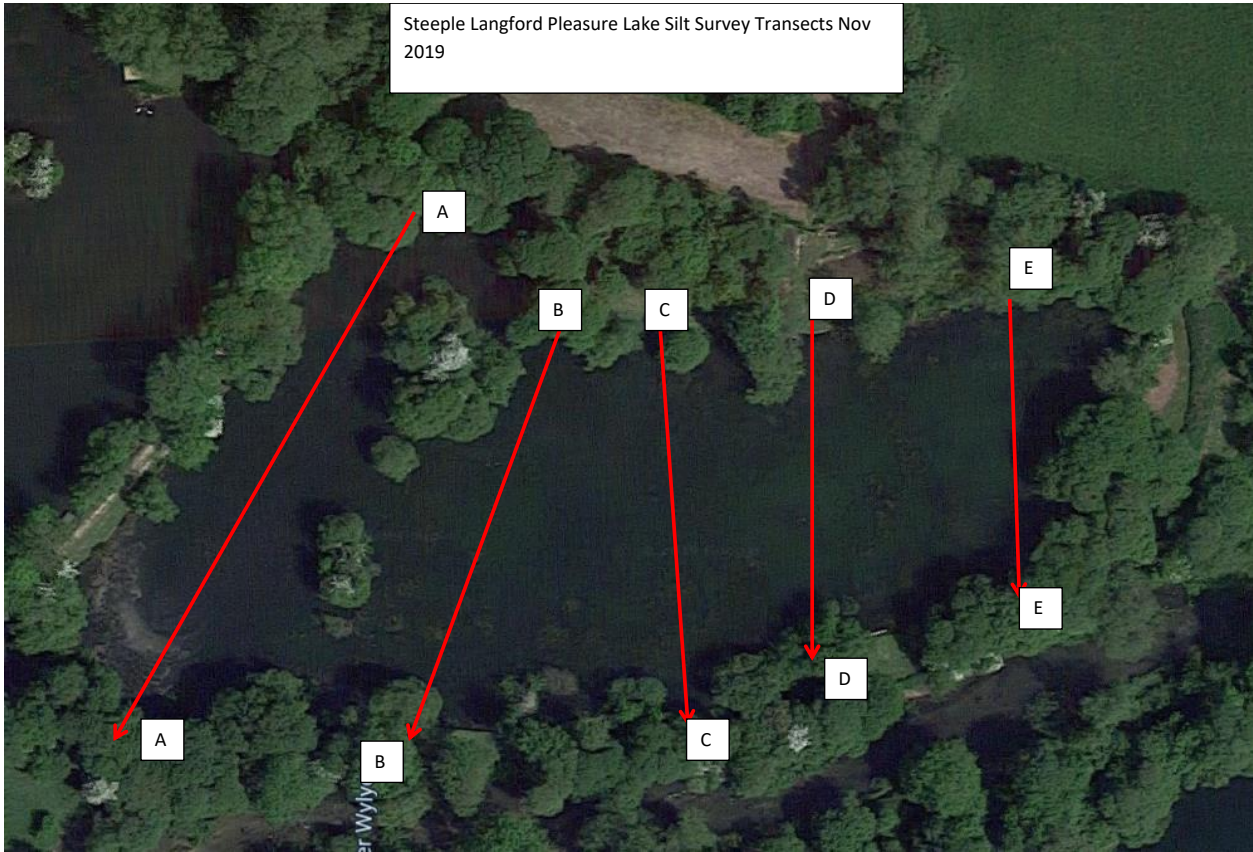
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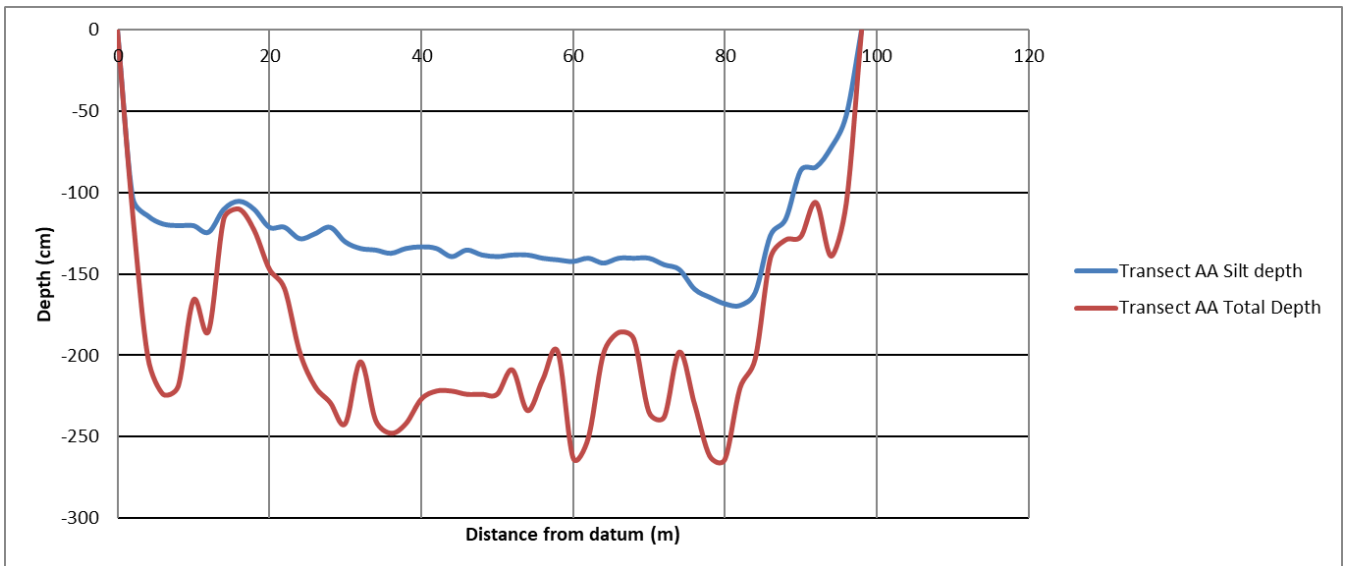
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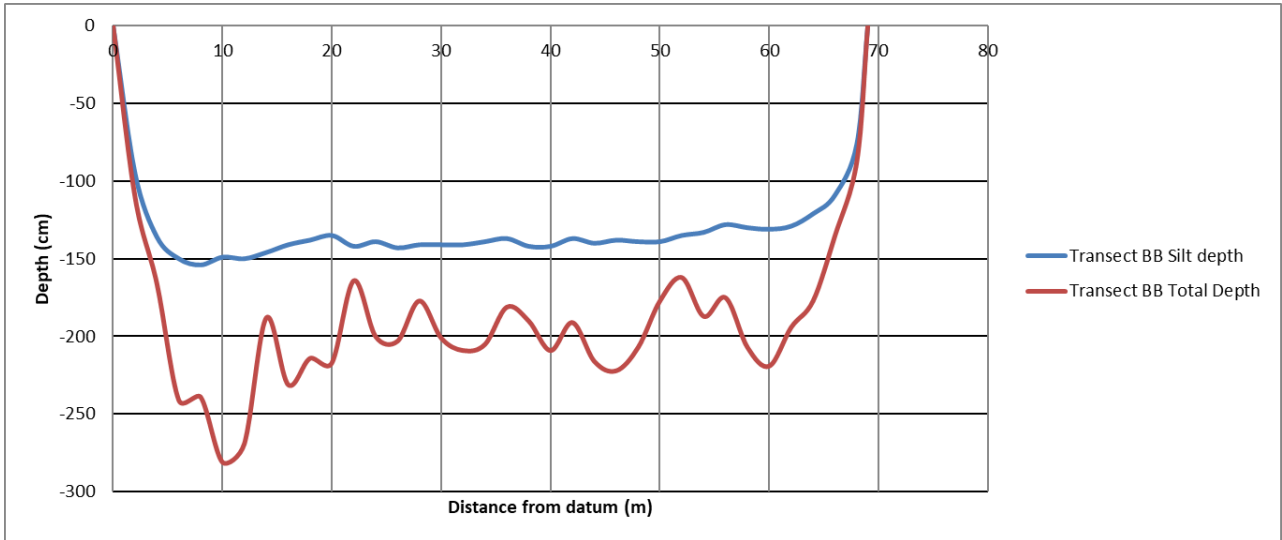
Pleasure Lake Silt Survey Results



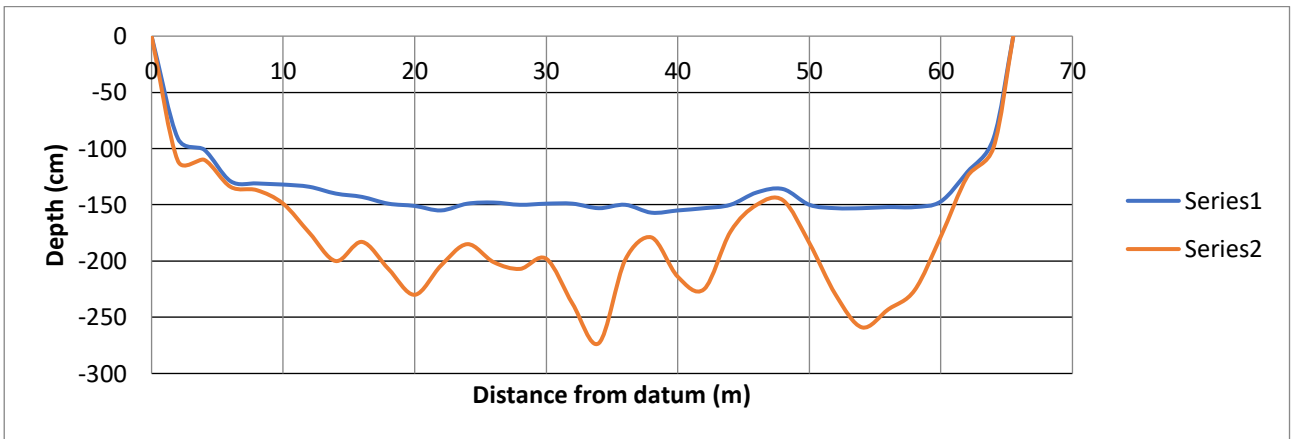
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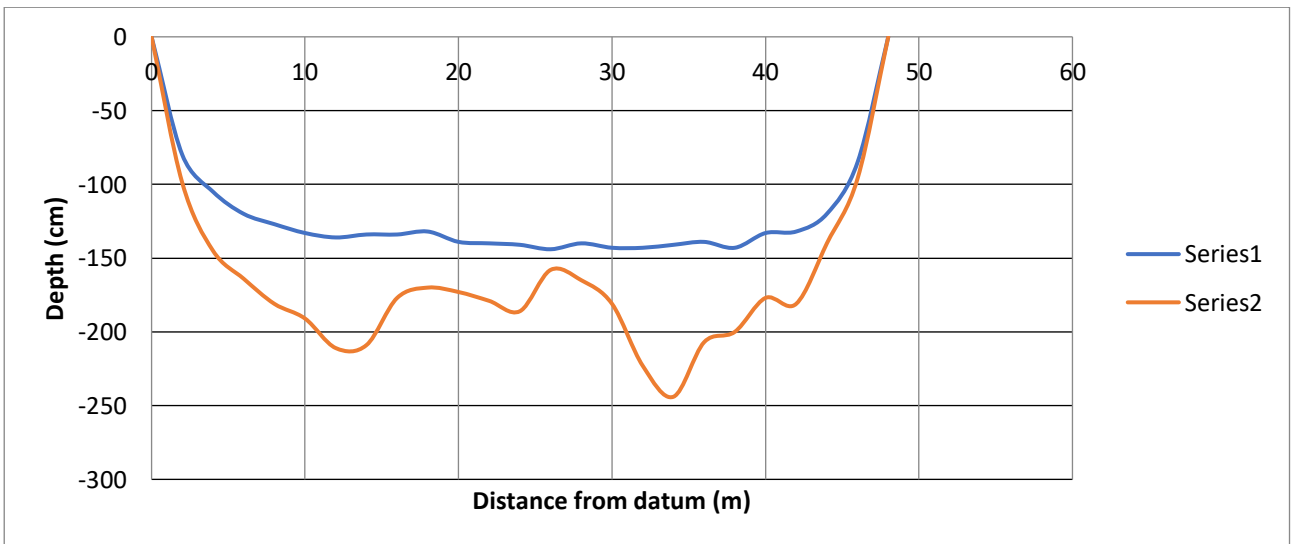
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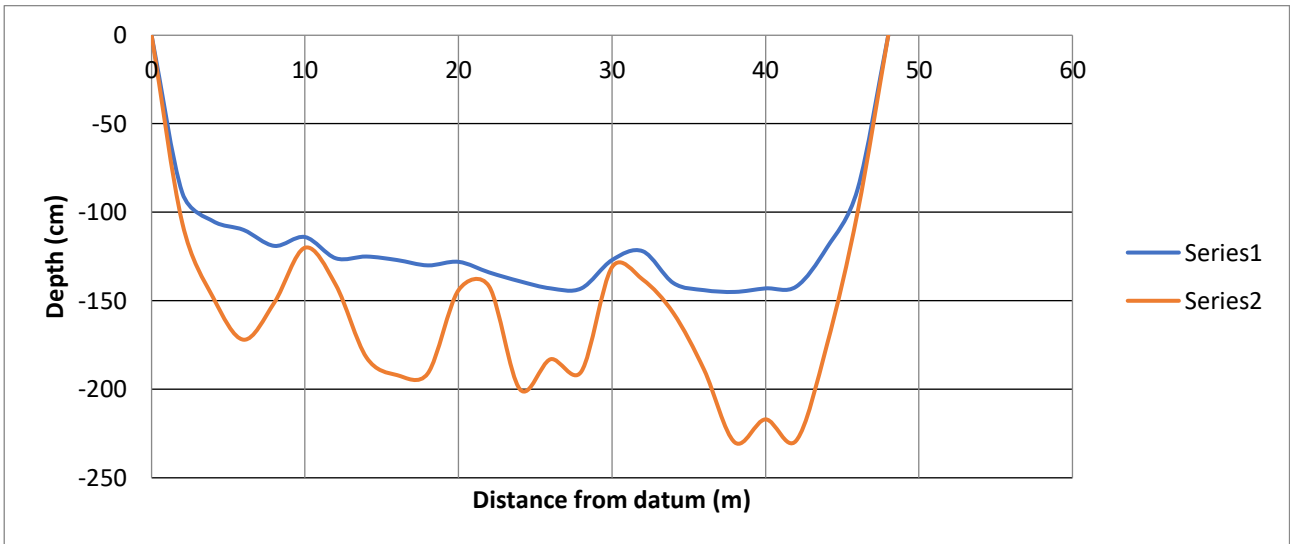


Table 2: Pleasure Lake silt survey complete results

Distance from datum (m)	TRANSECT A-A			TRANSECT B-B			TRANSECT C-C			TRANSECT D-D			TRANSECT E-E		
	Corner			First island tip to swim next to									3rd gap to Left ov V pad swim		
	Clear Water depth (cm)	Total Water Depth (cm)	Notes	Clear Water depth (cm)	Total Water Depth (cm)	Notes	Clear Water depth (cm)	Total Water Depth (cm)	Notes	Clear Water depth (cm)	Total Water Depth (cm)	Notes	Clear Water depth (cm)	Total Water Depth (cm)	Notes
0	0	0		0	0		0	0		0	0		0	0	
2	103	113		95	110		91	111		80	99		89	106	reeds
4	114	201		136	166		101	110		105	145		105	148	reeds
6	119	224		150	241		129	134		120	164		110	172	reeds
8	120	219		154	239		131	137		127	181		119	151	
10	120	166		149	281		132	149		133	191		114	120	
12	124	185		150	269		134	175		136	211		126	141	
14	110	116		146	188		140	200		134	209		125	182	
16	105	110		141	231		143	183		134	177		127	192	
18	110	123		138	214		149	207		132	170		130	191	
20	121	147		135	217		151	230		139	173		128	144	
22	121	159		142	164		155	204		140	179		134	142	
24	128	198		139	200		149	185		141	186		139	200	
26	125	219		143	203		148	201		144	158		143	183	
28	121	229		141	177		150	207		140	165		143	190	
30	130	242		141	201		149	198		143	181		127	131	
32	134	204		141	209		149	238		143	223		122	138	
34	135	240		139	205		153	273		141	244		140	157	
36	137	248		137	181		150	199		139	207		144	189	
38	134	242		142	190		157	179		143	200		145	230	
40	133	227		142	209		155	214		133	177		143	217	
42	134	222		137	191		153	225		132	181		142	229	
44	139	222		140	216		150	174		120	140		120	175	
46	135	224		138	222		139	150		85	96		87	100	
48	138	224		139	207		136	146		0	0		0	0	
50	139	224		139	177		150	184							
52	138	209		135	162		153	230							
54	138	234		133	187		153	259							
56	140	215		128	175		152	243							
58	141	198		130	207		152	226							
60	142	263		131	219		147	178							
62	140	251		129	194		121	125							
64	143	199		121	177		91	99							
66	140	186		109	135		0	0							
68	140	190		76	87										
70	140	235		0	0										
72	144	238													
74	147	198													
76	159	230													
78	164	262													
80	168	264													
82	169	220													
84	161	202													
86	126	140													
88	116	129													
90	86	127													
92	84	106													
94	72	139													
96	52	106													
98	0	0													

Algae manifestation in fresh water

- Algae cause a number of problems in water affecting fish and invertebrates, but also creating a health hazard to humans, livestock and wildlife.
- The frequency and abundance of algae blooms are increasing because nutrient concentration in water is rising as a result of human activity and natural processes.
- The need to control algae, therefore, is increasing for environmental, recreational and public health reasons.
- Because of their extremely small size and rapid growth rates, unicellular algae are difficult to control by methods used for other aquatic plants.
- Algae are susceptible to herbicides, but this approach is unpopular in some water on environmental or public health grounds. Herbicides also kill higher plants therefore restricted competition from the higher plant in future may worsen the problem.
- The application of barley straw to water has been tested in a wide range of situations and in many countries and has proven to be very successful in most situations with no known undesirable side-effects.
- Despite the simplicity of the idea, experience has shown that there are a number of basic rules that must be followed to ensure that the straw works successfully.

Barley Straw Activating Process

- Barley Straw works more effectively and for longer periods than wheat or other straws and should always be used. Green plant materials should not be used because they release nutrients, rot rapidly and cause deoxygenation.
- When barley straw is applied to water it starts to decompose and during this process chemicals are released which inhibit the growth of algae. Rotting is a microbial process and is temperature dependent, being faster in summer than in winter. It may take 6-8 weeks for straw to become active when water temperatures are below 10°C but only 1-2 weeks when the water is above 20°C.
- During this period initial activating period, algae growth will continue unchecked.
- Once the straw has started to release anti-algal agents it will remain active until it has almost completely decomposed. The duration of this period varies with the temperature and the form in which the straw is applied.
- The straw should remain active for between four and six months, after which its activity decreases rapidly.

Barley Straw Chemical Decomposing Process

1. When straw is first placed in water, the soluble components of the straw are washed out. These compounds are likely to be a mixture of carbohydrates and hemicelluloses. Bacteria are the most dominant micro-organism at this stage growing on carbohydrate reserves in the straw.
2. After about two weeks, temperature depending, the dominant micro-flora changes to fungi. This is when decomposition of lignin and other cell wall components starts to occur by lignase enzymes produced by fungi.
3. When straw rots, the cell wall components decompose at different rates. Decomposition of lignin leads to the production of a form of soluble lignin and other decomposition products. These decomposition products are likely to be transformed by bacterial and fungal enzyme activity before being released in to the surrounding water.
4. This mixture of compounds is transformed into fulvic and humic acids. These humic substances are referred to as Dissolved Organic Carbon or DOC. DOC is a natural component of many freshwater and marine ecosystems. When sunlight shines onto water which contain humic substances, in the presence of dissolve oxygen and sunlight hydrogen peroxide ($H_2 O_2$) is eventually formed.
5. High molecular weight DOC absorbs sunlight energy and can pass this energy to dissolved oxygen molecules. The dissolved oxygen becomes unstable and decomposes into two singlet oxygen radicals. These are very short lived, of the order of 1 micro-second, but extremely reactive molecules. The singlet oxygen radicals form superoxide radicals and these decay to hydrogen peroxide in water. The hydrogen peroxide is slightly more stable and persists for approximately 2 days in freshwater. The presence of a continuous supply of the right form of DOC creates conditions whereby hydrogen peroxide and the other oxidizing agents can be continuously produced.
6. Concentrations of 2 ppm Peroxide have been demonstrated to inhibit the growth of blue-green algae. Experiments have shown that sustained low concentrations of hydrogen peroxide can have a very similar effect on algae to that of straw.

Volume of Barley Straw Required

- We have found that the most important measurement in calculating the quantity of straw required is the surface area of the water.
- Surprisingly, the volume of the water does not appear to affect the performance of the straw as might be expected.
- This is because the majority of algal growth takes place in the surface layers of the water and so it is not necessary to measure the depth of the water or volume of the lake when calculating the quantity of straw required.
- In still waters, the initial dose rate of straw should be between 25- and 50-grams straw per square metre of water surface (gm-2).
- The next dose rate should be about half the initial rate, or about 25 gm-2.
- Once the algal problem has been reduced, further additions of straw should be made to prevent a recurrence of the problem. At this stage the dose can be reduced to the maintenance dose rate of 10 gm-2.

Fishery Surface Area and Weight of Barley Straw Application

Fishery	Surface Area (m2)	1st Barley Straw Application at 50g/m2 (Kg)	2nd Barley Straw Application at 25g/m2 (Kg)	Maintenance dose Barley Straw Application at 10g/m2 (Kg)
Leominstead Lake	11,550	577.5	288.75	115.5
Hamer Lake	37,482	1874.1	937.05	374.82
Petersfinger Hands Lake	12,317	615.85	307.925	123.17
Petersfinger Clarks Lake	13,151	657.55	328.775	131.51
Steeple Langford Pleasure Lake	9,019	450.95	225.475	90.19
Steeple Langford White Bird Lake	35,850	1792.5	896.25	358.5
Dandy's Lake	3,664	183.2	91.6	36.64
Nightingale Lake	3,624	181.2	90.6	36.24
Hayward's Pond	4,218	210.9	105.45	42.18

- A large Barley Straw Bale produced on farms 'weighs approximately 330kg
- In turbid or muddy waters, it will always be necessary to add more straw than in clear, mud-free waters. It is clear from numerous trials in different types of water body that the quantity of straw needed can vary considerably and it is better to apply too much initially and then to reduce the quantity gradually each time straw is added until the dose has been reduced to 10g m-2 or until algal growth starts to increase again when the dose should be increased to a previously effective level.
- Barley straw decomposes slowly and the oxygen demand of micro-organisms is unlikely to cause any problems unless excessive amounts of straw (more than 500 gm-2) are applied.

How to Apply Barley Straw

- Organic barley straw can be sourced and applied if available.
- Straw should be applied in a loose form, either in gabions or as straw sausages. This increases the diffusion of oxygen to the site of decomposition and speeds up the process in this type of environment
- Wrapping large quantities of loose straw in tubular netting normally sold for wrapping Christmas trees.
- In still or very slow flowing water, bales should not normally be used as they are too tightly packed and do not allow adequate water movement through the straw.
- The length and size of each sausage is determined by the size and shape of the water body. It is advisable to incorporate some floats within the netting or better still suspend the sausage, to keep the straw near the surface when it becomes waterlogged.
- Straw should be supported so that it does not sink to more than one metre below the surface, even when waterlogged.
- When first constructed, the barley straw sausages float well, but will sink when wet through.
- It is always preferable to apply several small quantities of straw to the water body rather than one large one. This improves the distribution of the active factors throughout the water body.
- Straw works best if it is held near to the surface where water movement is greatest. This keeps the straw well oxygenated and helps to distribute the anti-algal compound.
- In addition, this ensures that the compound is produced close to where the majority of the algae are growing and away from the bottom mud which will inactivate the compound.
- The following aspects should be considered when deciding where to place the straw within a water body.
- it can be assumed that the anti-algal compound will diffuse outwards in all directions from each net of straw gradually being absorbed by algae and inactivated by mud until the concentration becomes too low to be effective. Beyond this distance, algal growth will continue unchecked and these algae will gradually drift back into the treated areas giving the impression that the straw is not working.
- In order to ensure that there are no areas within the water body unaffected by the straw, it is necessary to calculate how much straw is needed, how many nets should be employed and how far apart each net should be.
- Nets or sausages of straw should then be placed so that each net is roughly equidistant from its neighbours and from the bank.
- From the point of view of getting maximum benefit from straw, it would also be preferable to place the straw as a barrier across the flow of water.
- Filamentous algae are not easily controlled by straw once they have formed floating mats. However, they can be controlled by other methods. In some situations, filamentous algae can be raked out. However, many fragments will remain in the water and rapid regrowth is likely. To prevent this straw should be added about one month before the alga is raked out.

When to Apply Barley Straw

- Although straw can be applied at any time of year, it is much more effective if applied before algal growth begins. This is because the anti-algal agents released by the straw are more effective in preventing algal growth than in killing algae already present.
- Therefore, straw is best applied in the spring and autumn, when water temperatures are low. The straw will become active within a month and will continue to inhibit algal growth for about 6 months.
- However, rapid algal growth can take place once the straw has rotted away and so further applications should be made every 4 to 6 months.
- It is important to note that the rate at which straw rots varies considerably and regular observations should be kept on the straw so that fresh straw can be added before the end of the 6 month period if necessary.
- Some algae, mainly the small unicellular species and the cyanobacteria (blue-green algae), can be controlled by adding straw to existing blooms.
- At water temperatures above 20°C straw has been effective in controlling algal blooms within 4-5 weeks, sometimes even faster.
- Avoid applying straw during prolonged periods of hot weather as the combined effect of the dying algae and the rotting straw may increase the risk of deoxygenation.
- At lower temperatures, the process is slower and it may take 8 - 10 weeks to control the algae but the risk of deoxygenation is then minimal. An advantage of lower temperatures is that the straw lasts longer too.
- If the straw starts to smell then it is not working and should be removed. This is caused by too much straw in too little water.
- The Barley Straw and all wrapping must be removed after 6 months, 4-6 weeks after the successive Barley Straw has been applied.

Other Effects Barley Straw Applications Have

- During the numerous field trials in which straw has been applied in a number of forms and in a range of water bodies, various effects in addition to the control of algae have been noted.
- Effects on other aquatic plants. No direct effect of straw on aquatic vascular plants has been found in either laboratory or field experiments.
- However, in several trials where straw has successfully controlled algae, there has been a noticeable increase in the growth of submerged vascular plants. It is likely that this is a result of the loss of competition from the algae, which has allowed the vascular plants to recolonise water in which previously they were unable to compete with the algae.
- In some instances, the recovery of the vascular plants has been so marked that they, in turn, caused problems to water users and required some form of management. However, they are generally easier to control and less troublesome than the algae and so are more acceptable in most waters.
- In some instances, the recovery of the vascular plants has been so strong that they replaced the algal growth as the dominant plant form so that subsequent treatment
- It has been observed frequently that loose masses of well oxygenated straw provide a good habitat for aquatic invertebrates such as the Water Shrimp (*Gammarus* spp.).
- These invertebrates, mostly detrital feeders, breed and grow rapidly in the safe environment created by the straw and their numbers can increase by several orders of magnitude within a few months.
- As the straw gradually rots away and the numbers of invertebrates increases, individuals leave the safety of the straw and become prey to fish and waterfowl.
- Invertebrates are beneficial to water bodies as they help to decompose organic matter in the bottom; some of them graze on algae and aquatic plants and they form an important part of the food chain.
- Increased densities of Zooplankton, which natural grazers of algae, have also been recorded within and around the straw bundles.
- There have been a number of observations of improved growth, vigour and health of fish in waters treated by straw. One reason for this is likely to be the increased food supply in the form of invertebrate animals.
- Fish may also find it easier to find food in water that is not densely colonised by unicellular or filamentous algae. However, another possible explanation is that, by controlling the algae, the straw allows better light penetration to occur to deeper levels in the water so that photosynthesis can occur in a greater volume of the water body and so provide an improved environment for the fish.
- The Game Conservancy has also noted that young ducklings require a diet that consists mainly of invertebrate animals. They found that adding straw to gravel pits significantly increased the survival of young ducklings.
- It has also been observed that the Straw offers spawning media and refuge for juvenile fish increasing recruitment.

Netting Plan Steeple Langford White Bird: Author: Paul Clancy BSc (SADAC Keeper)

Objective

- The activity aim is to obtain the most accurate stock density estimate, whilst under taking the stock estimates an investigation into the to the health of the stock should also be conducted.
- The stock estimate will also give an estimation of the fish community and the percentage different species represent in the water body.
- The stock Assessment aim should consider obtaining length and weight measurements and in-turn the condition factors for each species present.
- A sample of fish required for a Health Check may also be considered and retained.
- The large expensive specimen King Carp (*Cyprinus carpio*) captured during the activity need as well as their length/weight recording they require individually with tagging, if not already tagged, and photographing for future reference.

Equipment

- 90m polypropylene rope for pulling net in front of reed bed,
- 2x posts and Maul for fixing stop net
- 100m seine net and 38m seine net fixings to join nets
- 75m seine nets
- Flat bottom Punt boat and outboard motor and battery for deploying seine net
- 5x Extendable seine net support sticks
- 2x Dip nets
- 4x floating holding nets with lids and Carp holding sacks
- Numerous bank sticks
- Fish holding cradles and protective mats
- Buckets for holding small fish for processing
- 2x measuring boards
- Small Digital Scales for weighing fish less than 0.5kg
- Larger hanging scales for weighing fish greater than 0.5kg up to 22kg
- Waterproof recording paper sheets and pencils
- Tweezers and small envelopes for collecting scale samples
- Hole punch for fin clipping, disinfectant for clippers and clipped fins
- Digital Camera for recording large specimen Carp
- Tagging gun with tags and Digital Tag reader
- Small transport tank and battery air pump for transporting Health Check sample
- Lifejackets for operatives, Rescue Throw Rope and first aid kit
- PPE: Dry suits, Gloves, Waders
- Spray bottle with Virkon to disinfect any potential contaminated kit

Methodology

- It is imperative that this netting is conducted with the same process, effort and efficiency each time. Any alteration or deviation from the stated method needs to be avoided, if it does occur it needs to be recognised and recorded as it can skew results and analytical findings.
- The larger sweep of the lake possible will increase the chance of capturing a larger sample size for analysis.
- It must be recognised that this will still only give an estimate of the stock as fish will access different refuge areas within the lake during different environmental conditions and the disturbance caused on the specific day.
- All fish caught are classed as the total sample caught.

Shooting and Setting Seine Net

- Before netting commences a 2m stop net is to be placed in front of the lakes out flow on the south end of the causeway.
- With the clubs 100m and 38m seine nets joined this will enable a large sweep of the entire lake. The net will be deployed from Point A (Green) in the corner of the bay behind the spit on the south bank and along the south bank towards the west end of the lake
- From Point A (Green) the 138m net will be deployed along the south bank towards Point B (Red) from a boat as quietly and quickly as possible **Figure 1**.



Figure 1: Location of shooting the white bird lake seine nets

- From Point B (Red) a rope will be attached to enable this end of the seine to be pulled along the deep reed beds edge as quickly and quietly as possible, whilst Point A (Green) moves along spit towards the main body of the lake **Figure 2**.



Figure 2: Net Direction of Travel

- Once the red end of the net has reached the north bank then the net can begin to be swept down the lake at both ends.
- Care must be taken to work the net under or around over hanging obstacles as quickly as possible whilst causing disturbance to drive fish out of the refuge or possible escape route.
- The net will be at its full length to cover the total width of the lake this will require man power to keep the net moving. It is suggested that at least four fit and able persons be on either end of this large seine **Figure 3**.



Figure 3: Seine net sweep at its widest part

- Once the 138m Seine net has reached the island in the north east corner of the lake the Green end stops and the Red end continues around the back of the island towards the causeway **Figure 4**.



Figure 4: 138m Seine nets stop position

- The 138m seine net is now pulled tight and fixed in position with stakes and has now become a stop net.
- With the stop net now in place, the 75m seine net is shot along the stop net from the causeway in front of the island and along stop net towards the south bank and the land point. At the same time the net end on the causeway is drawn along the causeway to the designated landing point **Figure 5**.
- The 75m seine can be retrieved in the usual manner making sure lead line is not lifted and float line is not sunken.
- When the purse of the seine is secure with the leads up on the bank the float line can be raised with net supports to prevent fish from jumping out of the net.
- The captured sample can now be graded into floating keep nets ready for recording.



Figure 5: 75m Seine net deployed from causeway and seine landing site

Depletion Method Netting

- With the fish retained in holding nets ready for recording a second sweep of the netting area can take place using the exact same method as before.
- The fish captured in this sweep will be retained in a separate holding net whilst the third and final sweep of the same area can take place.
- These three nettings should show a depletion in abundance each time it undertaken. The data from the exercise can then be analysed to give estimate of the total stock

Sample Recording

- Fish from each sweep will be intern identified and recorded with their length and weight details.
- Unless a sample is to be retained for a health check then a sample of fish shall have scales removed placed in envelopes with the length weight and species noted on the front for aging the fish against their length weight statistics at a later date.
- The required sample of fish for a health check will consist of at least fifteen individuals and be made up of specimens up to 10cm representing the stock captured.
- Depending on the amount of fish caught a random representative sample maybe processed due to the large numbers of fish to deal with.
- The representative sample will be multiplied by the number of same size nets which makes up the total catch to give an estimate of the catch.

Representative Sample

- Depending on the amount of fish caught a random representative sample maybe processed due to the large numbers of fish to deal with.
- The representative sample will be multiplied by the number of same size nets which makes up the total catch to give an estimate of the catch.

Mark and Recapture Individuals

- The decision may be taken that an additional stock assessment method will be required due to the success of the depletion assessment.
- From the fish captured a species, that will represent the sample caught, shall be selected for a mark and recapture analysis.
- The selected specimens will be fin clipped so that they will be easily recognisable on recapture.
- Care must be taken so that the fin clips are in the same designated fin with causing minimal damage.
- The individuals marked are recorded, this data will be used in the sequential recapture exercise.
- **Recapture Marked and Unmarked Individuals**
- At least a week or two rest period is suggested before undertaking the recapture activity.

- The method used for the recapture process must be exactly the same as the initial stated method.
- This time great care is required to identify any marked fish and similar specimens which are not marked. This data is then used to calculate stock estimates.

Fish Movements

- If the netting activity has been successful and there is some captured fish which are needed to be moved from the lake, then through foresight a required Health Check and EA Fish moving permit will be required before the netting takes place.
- The only exception to this is the moving of fish to the adjoining Pleasure Lake on the Steeple Langford site. In this case a recent stock assessment (less than one year) of the Pleasure Lake would be required to ascertain the available space for new stock as with any water receiving new fish stocks.
- The fish selected to be moved must also be appropriate and in keeping with the management plan for the destination fishery.

Risk Assessment (hazards / control measures):

- **Hooks in trees & net:** all to wear gloves & to keep a close eye out for fishing tackle in vegetation & caught in seine / stop / dip nets.
- **Cold:** all to come prepared for a long, cold day: gloves & woolly hat essential; thermal layers recommended; neoprene gloves essential. Flask of hot drink recommended.
- **Slips & trips:** bank is wet & slippery at this time of year – warn others of problem areas & beware of losing control of heavy equipment, such as boat, net tubs etc.
- **Hygiene:** fishery is known to have rats, other mammals & lots of wildfowl at times – use antibacterial wipes before eating & at end of job.
- **Manual handling:** use good lifting technique & double lift for any heavy kit, e.g. nets, outboard batteries, boat, weights etc.
- **Outboard prop blades:** the outboard prop blades are not guarded and are designed to slice through weed – never drive boat close to people in the water and always keep all body parts away from prop. If prop needs lifting from water, double-check control is in neutral position & wear gloves when clearing.
- **Biosecurity measures:**
- All kit & PPE to be checked, cleaned & dried before arrival on site. Any kit at risk of being contaminated or unable to be dried will need to be submersed in Virkon solution tanks for 24hrs before use.
- Nets, boat & PPE to be cleared, rinsed & dried as much as possible on site after job, to avoid transfer of pathogens & plant material off site.

Netting Plan Steeple Langford Pleasure Lake: Author: Paul Clancy BSc (SADAC Keeper)

Objectives

- The activity aim is to obtain the most accurate stock density estimate, whilst under taking the stock estimates an investigation into the to the health of the stock should also be conducted.
- The stock estimate will also give an estimation of the fish community and the percentage different species represent in the water body.
- The stock Assessment aim should consider obtaining length and weight measurements and in-turn the condition factors for each species present.
- A sample of fish required for a Health Check may also be considered and retained.
- The large expensive specimen King Carp (*Cyprinus carpio*) captured during the activity need as well as their length/weight recording they require individually with tagging, if not already tagged, and photographing for future reference.

Equipment

- 80m polypropylene rope
- 2x posts for fixing rope and intern Partitioning net at Points A and B and Maul
- 1x 75m seine net used to partition the lake
- 1x 21m seine net used as stop net around sunken tree
- 1x 100m seine net as the sweep net
- Flat bottom Punt boat and outboard motor and battery for deploying seine net
- 2x Dip nets
- 5x Extendable net support sticks and small Numerous bank sticks
- 4x floating holding nets with lids and Carp holding sacks Fish cradles and protective mats
- 2x measuring boards
- Buckets for holding small fish for processing
- Digital Scales for weighing fish less than 0.5kg
- Larger hanging scales for weighing fish greater than 0.5kg up to 22kg
- Waterproof recording paper sheets and pencils
- Tweezers and small envelopes for collecting scale samples
- Digital Camera for recording large specimen Carp
- Tagging gun with tags and Digital Tag reader
- Small transport tank for transporting Health Check sample
- Life vest for operatives, Rescue Throw Rope and first aid kit
- PPE: Dry suits, Gloves, Waders
- Spray bottle with Virkon to disinfect any potential contaminated kit

Methodology

- Due to the expanse of water with presence of islands and the equipment available only a partial sweep of the lake body is possible.
- It is imperative that this netting is conducted with the same process, effort and efficiency each time. Any alteration or deviation from the stated method needs to be avoided, if it does occur it needs to be recognised and recorded as it can skew results and analytical findings.
- The larger sweep of the lake possible will increase the chance of capturing a larger sample size for analysis. It must be recognised that this will still only give an estimate of the stock as fish will access different areas of the lake during different environmental conditions on the specific day.
- With the clubs two 75m x 5m seine nets one will act as a stop net partitioning the lake in two. This will enable a large sweep of the southern part of the lake.
- The net will be deployed from Point A on the car park bank to Point B on the south bank from a boat as quietly and quickly as possible.

- A rope will be put in place between Points A and B a day or two before ready to pull the net boat from Point A to Point B deploying the net out behind the boat.
- The 21m net will be put in place around the large sunken tree on the car park bank to stop fish from refuging in tree whilst netting takes place.

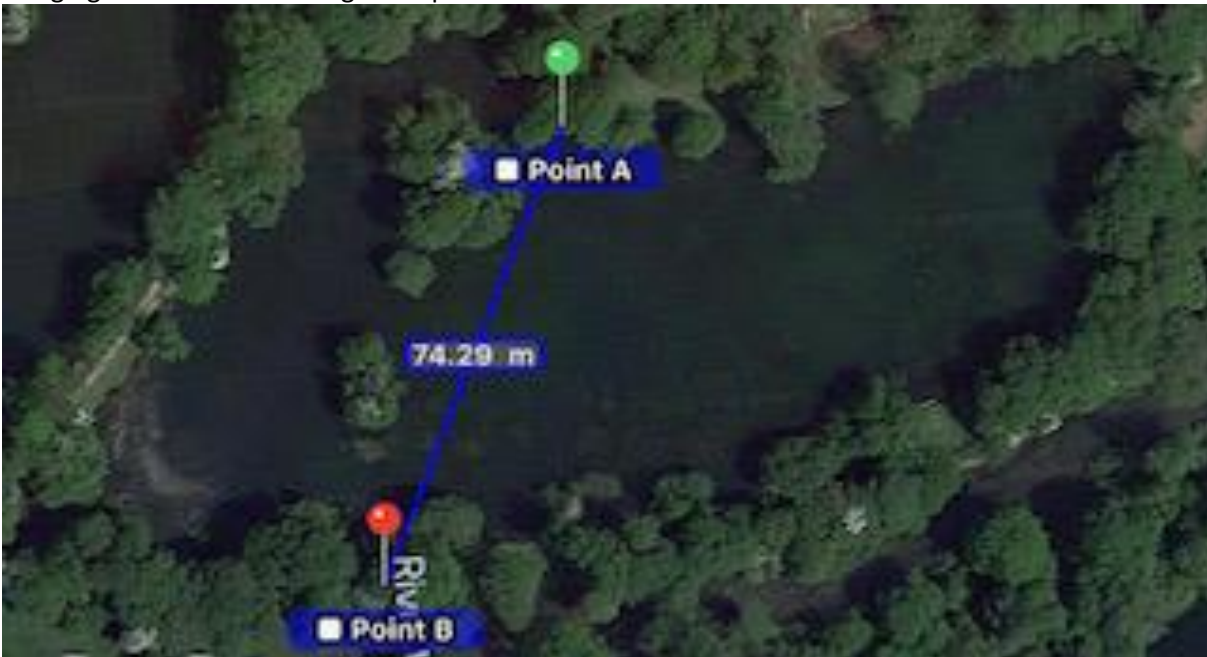


Figure 1: Location of the Pleasure Lake partitioning net



Figure 2: Location of the Pleasure Lake netting landing site

- The net boat will then be used to deploy the 100m seine net from the corner of the outlet channel around the west bank to the south bank ready to do a sweep of the lake.
- The designated landing site for the seine net is on the car park bank between partition net and the sunken tree.
- The end of the sweep net on the car park bank is brought back towards the landing site at the same time as the net end on the south bank, with care and enough slack net taken to bringing the end around the sunken tree with stop net around it first.

- Then the southern end of the net will sweep the entire way along the south bank back to the partition stop net, then this end returns to the north bank along the partition net to the car park bank and then to the designated landing site on the car park bank.
- The 100m seine can be retrieved in the usual manner making sure lead line is not lifted and float line is not sunken.
- When the purse of the seine is secure with the leads up on the bank the float line can be raised with net supports to prevent fish from jumping out of the net.
- The captured sample can now be graded into holding nets ready for recording.

Sample Recording

- With the fish retained in holding nets ready for recording a second sweep of the netting area can take place using the exact same method as before.
- The fish captured in this sweep will be retained in a separate holding net whilst the third and final sweep of the same area can take place.
- These three nettings should show a depletion in abundance each time it undertaken. The data from the exercise can then be analysed to give estimate of the total stock
Fish from each sweep will be intern identified and recorded with their length and weight details.
- Unless a sample is to be retained for a health check then a sample of fish shall have scales removed placed in envelopes with the length weight and species noted on the front for aging the fish against their length weight statistics at a later date.
- The required sample of fish for a health check will consist of at least fifteen individuals and be made up of specimens up to 10cm representing the stock captured.
- Depending on the amount of fish caught a random representative sample maybe processed due to the large numbers of fish to deal with.
- The representative sample will be multiplied by the number of same size nets which makes up the total catch to give an estimate of the catch.

Netting Areas

- The Area of the Pleasure lake that is being netted is 5,531.33 m² that is 58.95% of the total surface area of the lake which is 9,382.32 m². This calculation will be used to estimate the total stock in the lake.



Figure 3 Netting surface area of Pleasure lake



Figure 4 Un-netted surface area of Pleasure lake

Fish Movements

- If the netting activity has been successful and there is some captured fish which are needed to be moved from the lake, then through foresight a required Health Check and EA Fish moving permit will be required before the netting takes place.
- The only exception to this is the moving of fish to the adjoining White bird Lake on the Steeple Langford site.
- In this case a recent stock assessment (less than one year) of the White bird Lake would be required to ascertain the available space for new stock as with any water receiving new fish stocks.
- The fish selected to be moved must also be appropriate and in keeping with the management plan for the fishery.

Risk Assessment (hazards / control measures):

- **Hooks in trees & net:** all to wear gloves & to keep a close eye out for fishing tackle in vegetation & caught in seine / stop / dip nets.
- **Cold:** all to come prepared for a long, cold day: gloves & woolly hat essential; thermal layers recommended; neoprene gloves essential. Flask of hot drink recommended.
- **Slips & trips:** bank is wet & slippery at this time of year – warn others of problem areas & beware of losing control of heavy equipment, such as boat, net tubs etc.
- **Hygiene:** fishery is known to have rats, other mammals & lots of wildfowl at times – use antibacterial wipes before eating & at end of job.
- **Manual handling:** use good lifting technique & double lift for any heavy kit, e.g. nets, outboard batteries, boat, weights etc.
- **Outboard prop blades:** the outboard prop blades are not guarded and are designed to slice through weed – never drive boat close to people in the water and always keep all body parts away from prop. If prop needs lifting from water, double-check control is in neutral position & wear gloves when clearing.
- **Biosecurity measures:**
- All kit & PPE to be checked, cleaned & dried before arrival on site. Any kit at risk of being contaminated or unable to be dried will need to be submersed in Virkon solution tanks for 24hrs before use.
- Nets, boat & PPE to be cleared, rinsed & dried as much as possible on site after job, to avoid transfer of pathogens & plant material off site.