Carp removal at Little Sea, Studland, Dorset: 2013-2022

Prepared for Natural England by [redacted]

[redacted]

October 2022

1.0 Introduction

Following the illegal introduction of common carp *Cyprinus carpio* into Little Sea, the National Trust (NT) engaged [redacted] to remove as many carp as practical and to carry out other management actions aimed at reducing their impact on the nature conservation value of the lake. This report summarises this work for the period 2013-22.

2.0 Evolution of fish removal

The working assumption is that carp were illegally stocked to Little Sea in the early 2000's. By 2012 it was apparent that they were having a significantly damaging impact on the lake's ecology, particularly its submerged macrophyte community.

Initial attempts to remove the carp centred on the construction of two large (6m x 6m) fish traps. These were adapted from fish farm cages; each was comprised of a central netted frame with 4 No. 20m leaders shepherding fish into a large one way 'lobster trap funnel' (inscale). Fish would in theory then enter and be trapped within the 6m x 6m netting enclosure from where they could subsequently be removed.

The traps were carefully designed to give free access to otters *Lutra lutra* through the inscale into an open area of water. They could then safely exit the water onto the surrounding walk-ways.

Despite deployment for the whole of summer 2013 and the obvious presence of fish immediately adjacent, the traps failed to catch a single carp. Otters did however find them a useful place to eat and digest the carp that they had themselves caught, potentially from the traps. The design of the trap did at least fulfil its brief to be 'otter-friendly', with the design having the potential for adaptation for the capture of other species elsewhere.

Figure 1: Construction of trap

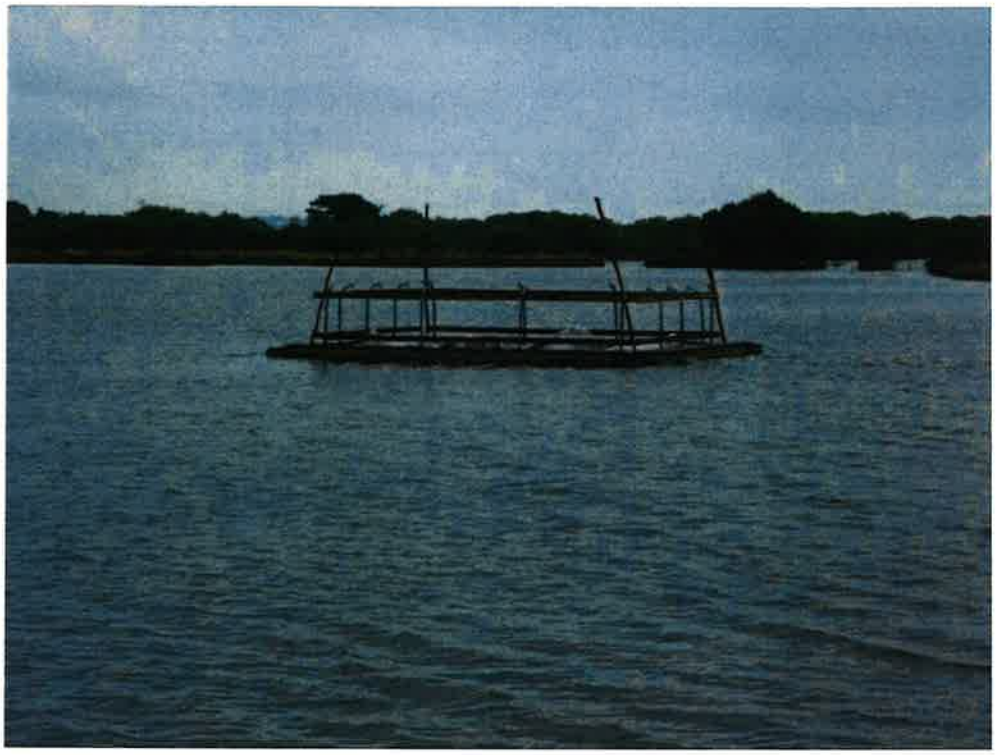

Figure 2: Trap deployed in Little Sea

Following the failure of the traps, a switch to 'active hunting' of fish was made in 2014, with the traps remaining in situ. The presence of live ordnance and the debris strewn bed of the lake precluded the use of seine netting. Permission for the use of gill nets was thus sought and granted by the Environment Agency. There were again significant restrictions on the use of this equipment. The presence of wildfowl and otters prevented leaving the nets to passively fish unattended, even for short periods of time. An exclusion on the use of petrol powered outboard motors and electrofishing equipment placed further limits.

In essence the final methodology involved setting a 100m x 2m gill net parallel to and perhaps 30m from a section of shoreline where carp were observed or believed to be. Staff then waded within the enclosed section of netting to scare carp and force them into the net. The method worked reasonably well but limitations were soon exposed:

- Setting nets quickly enough to prevent carp leaving the area was made hard in the absence of an outboard motor
- The lack of electrofishing meant that fish were able to evade staff by swimming under areas of undercut bank
- Carp were not always effectively caught in the gill nets, often 'bouncing' off them
- Carp became accustomed to both the presence of operatives and the nets, learning to swim parallel to them and jump over them. This learnt behaviour became more obvious as the season progressed

Fish entangled in the nets were quickly supported on floating unhooking mats and then untangled or cut out of the net using scissors. This minimised damage to the fish and

optimised their chance of subsequent survival. Fish were initially sold to local angling clubs, generating some additional revenue for NT which was re-cycled back into the project.

This methodology was modified into 2015, with a change to using trammel nets. These comprised a 100m x 2 or 3m deep net with three individual mesh walls, the outside pair being of very large mesh and the middle having a much smaller mesh size. The principle of trammel nets is that fish push into the smaller mesh and subsequently get entangled in a pocket formed by the coarser outer mesh. In practice these nets proved far more effective than the gill nets, with the use of the latter eventually abandoned later in 2015. Two 100m long trammels nets were also joined to form a single 200m long sheet of netting, giving the ability to cover a much longer length of bank.

Permission was granted to use a petrol-powered outboard engine in 2015. Permission was also obtained to use electrofishing equipment (following professional ordnance risk assessment) in October 2015. This meant that it was now possible to both effectively chase fish within the netted area into the trammel nets, and also to use electrofishing on its own along the margins of the lake. In combination, these changes significantly improved catch success.

In 2016, the fish traps were repurposed as tern rafts. An exclusion barrier was also erected to prevent carp entering the Western Arm as marked on Figure 3. The barrier comprised a pocketed geotextile (Nicospan) attached to wooden posts driven into the lake bed.

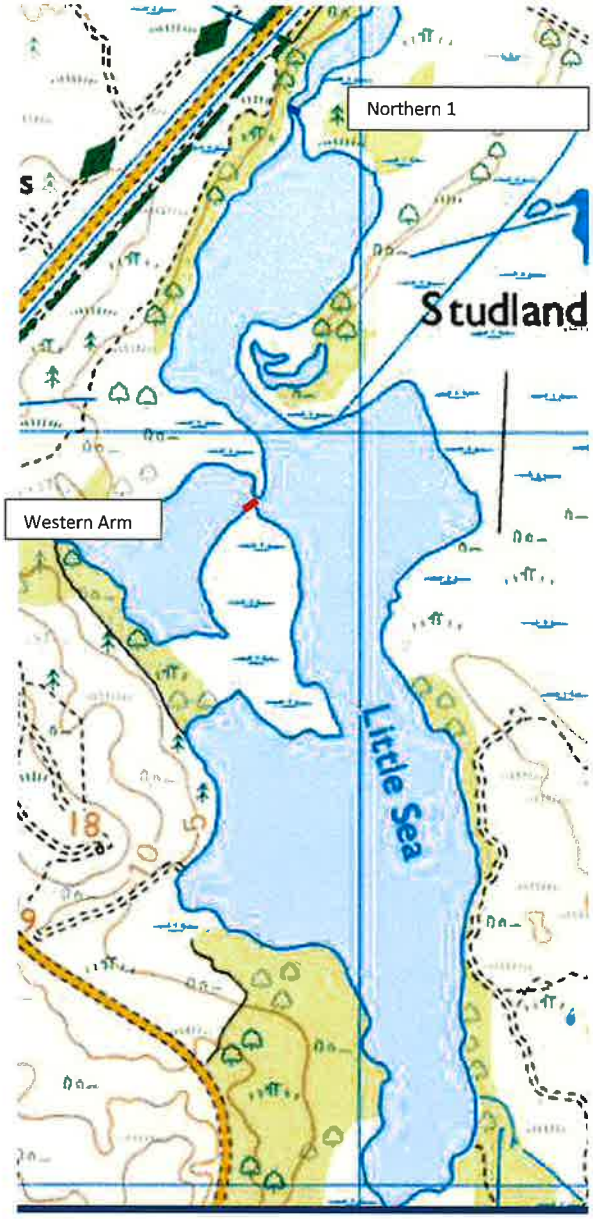

Figure 3: Little Sea showing location of exclusion barrier (red line) across the mouth of western arm and inscale (blue line) across the mouth of northern 1)

Further physical modifications were carried out in 2020, including the installation of a section of brushwood faggoting to isolate a 75m section of bank from carp and wave erosion.

2021 saw the erection of two 'cormorant roosts' to try and encourage the presence of this piscivorous bird species and the installation of a one-way valve (inscale) marked in blue on Figure 3 at the mouth of Northern 1.

Figure 4: Brushwood exclusion zone (left) and cormorant roosts (right)

Figure 5: Inscale for Northern 1 on the bank

Figure 6: Inscale installed

3.0 Seasonal fish movement

It is hard to be definitive regarding seasonal movements of carp in Little Sea. However. a few subjective trends do seem relatively clear. There was a strong migration of fish to the north of the lake in April/May with numbers of fish gathering in Northern 1 for spawning. Catches of fish in this area at this time were often large, with over 15 fish captured in a single setting of the trammel nets. Attempts to concentrate and trap carp in this area by installing an inscale in the neck of the arm have not been successful. Carp were reluctant to pass through the structure resulting in more fish gathering outside the arm and fewer fish within it. As a consequence the inscale was removed.

Other areas of the lake with extensive stands of common reed also attracted good numbers of carp during the April-June spawning period. The presence of breeding birds, particularly sedge warbler *Acrocephalus schoenobaenus* has however restricted access into the reeds for fish removal during peak carp spawning.

There has been some suggestion of an off-shore movement of carp post spawning. This movement became very pronounced in 2022, possibly reinforced by the low lake level exposing the marginal zone which previously provided refuge for carp. Setting nets in the open water areas of the lake in summer 2022 proved very successful with double figure catches of carp in individual settings of the net.

The 4.0 Recorded fish data

4.1 Total number of fish removed

Records of fish caught have been accurate but generally only a bulk weight of fish removed was recorded. There was initially no apparent need to keep records of individual fish length or weight. Latterly, individual fish data have been recorded.

As a consequence of these facts, the table below contains details of the weight of fish removed each year, with a few narrative comments where they were recorded.

Year	Number of fish removed	Weight of fish removed (kg)	Mean weight (kg)	Comments
2014	165+	554+	3.3	Good numbers of carp <1kg with numbers of fish <15cm also caught
2015	135	446	3.3	Ditto
2016	135	475	3.5	A lot of small fish <0.25kg plus some as small as 15cm caught
2017	80	265	3.3	Fish to 9kg with several of 1kg caught
2018	88	310	3.5	Largest fish >10kg with around 20 fish <0.5kg. A small number of roach and rudd >1kg caught
2019	79	120	1.5	A few smaller 10-15cm fish caught
2020	COVID RESTRICTIONS: NO FISHING UNDERTAKEN			
2021	126	388	3.1	Good number of fish <1.5kg
2022	189	569	3.0	More mirror carp present- evidence of additional stocking? Several individual fish >9.5kg
TOTAL	**997**	**3,127**	3.1	

Figure 7: Consolidated return of fish removed from Little Sea

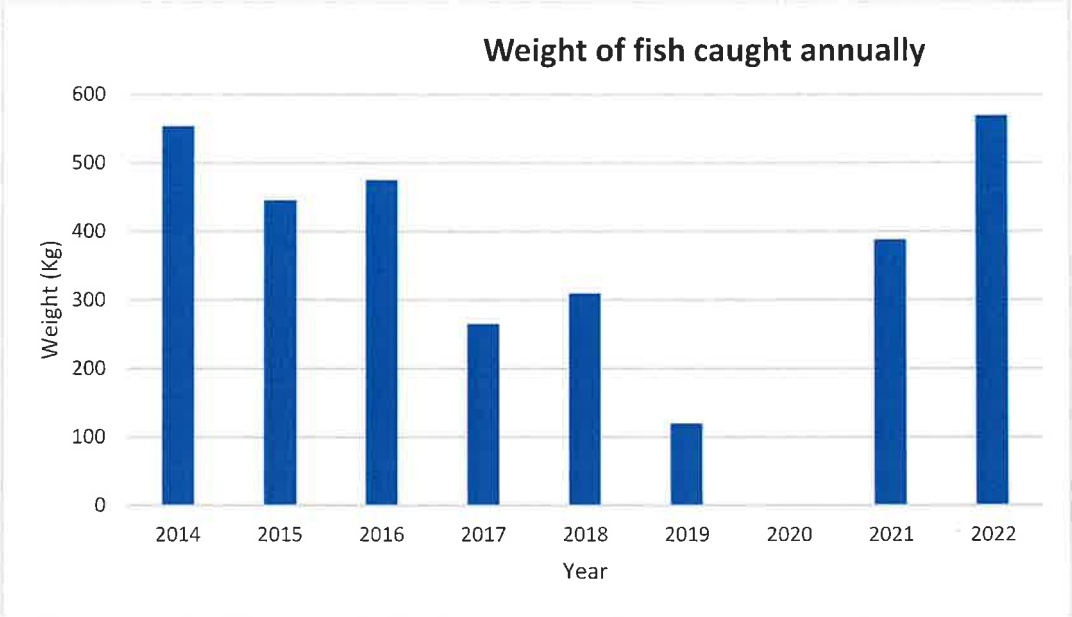

Figure 8: Weight (kg) of carp removed annually (no data for 2020: Covid)

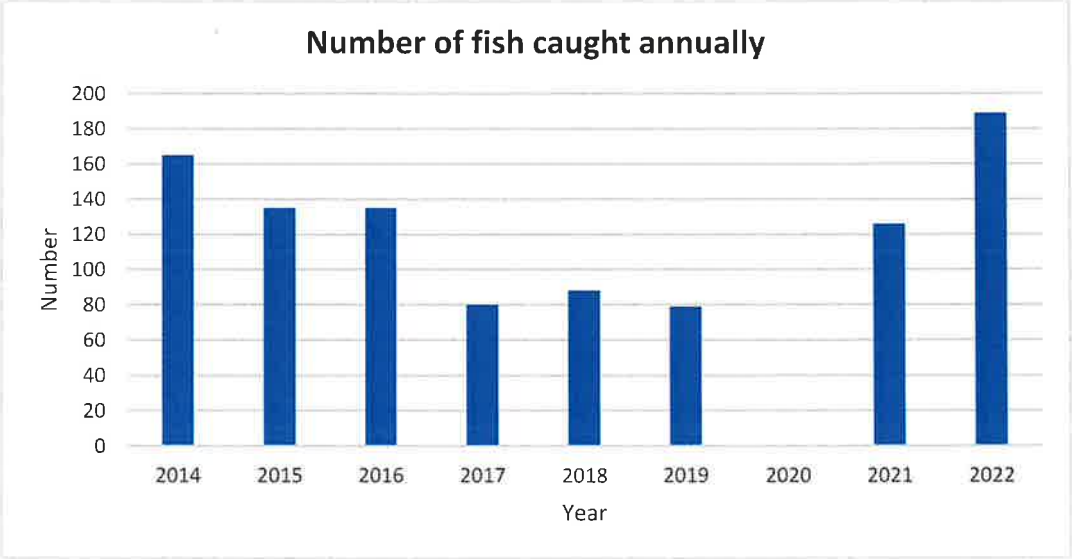

Figure 9: Number of fish removed annually (no data for 2020: Covid)

4.2 Individual fish weights

Individual fish weights have not been routinely recorded; there was no requirement to do so under the terms of the fish removal contract. In 2021 and 2022 however records were taken of individual weights of carp. Additional weight data have been extracted from fish health checks carried out. These data have been consolidated in Figure 10.

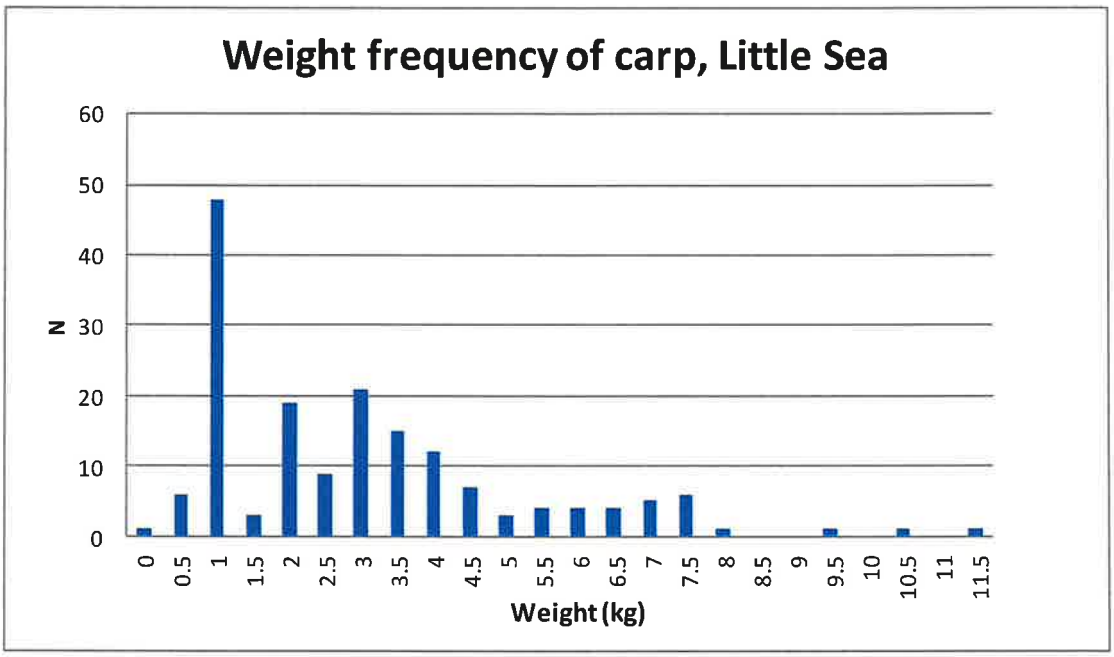

Figure 10: Weight distribution of carp removed (consolidated data 2021, 2022 and health check data)

2 June 2021

29 August 2019

29 August 2019

Figure 11: A sample of the carp caught at Little Sea, clearly showing recruitment of young fish

4.3 Age of carp

Aging fish is normally undertaken by counting growth checks on scales removed from individual fish. Although generally a relatively reliable method of aging fish, there are difficulties. Fish that have been physically damaged rapidly replace scales lost with no obvious growth checks. As fish get older and growth rate declines it becomes harder to discern individual annual checks. Ages stated should thus be regarded as minima; larger fish may well be older than the estimates provided. Carp, in particular mirror carp are notoriously tricky to age. The data below were recorded from a sub-sample of scales taken from carp in 2021 and 2022 and from fish autopsied for health checks since 2015. These are presented subject to the above caveats.

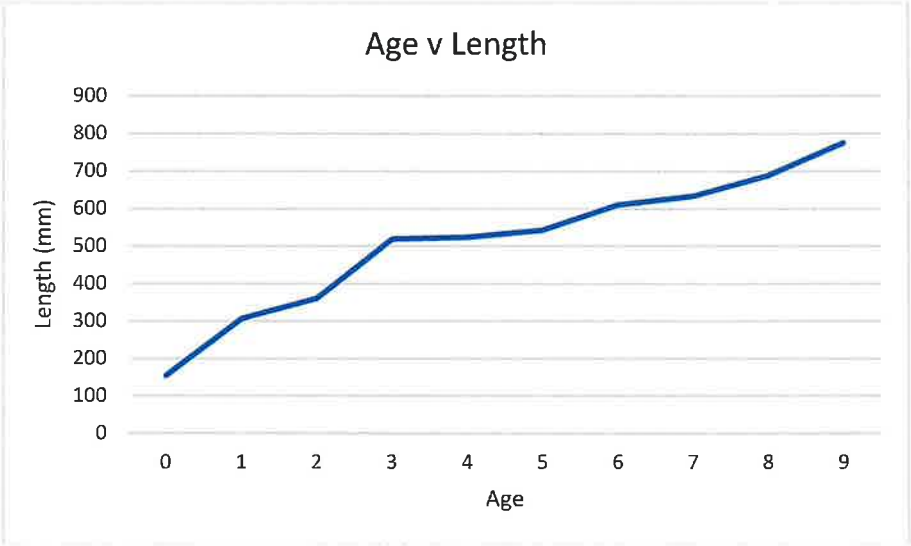

Figure 12. Length with age

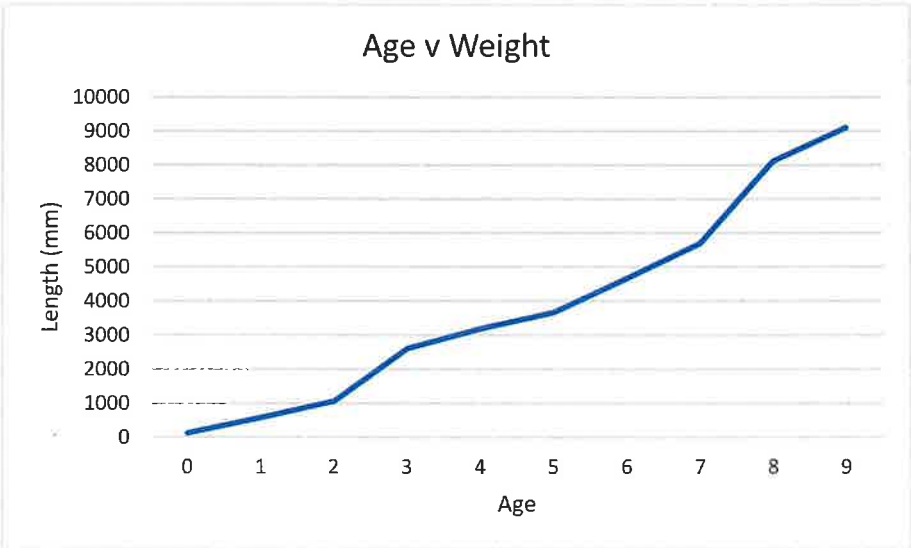

Figure 13. Weight with age

4.4 Health checks

As part of the EA fish movement protocol, health assessments are undertaken for fish removed from Little Sea. Some records could not be found (paper copies destroyed) but samples from 2014, 2015 and 2018 are provided below for information.

THAMES VALLEY AQUATIC SERVICES
[redacted]
Telephone [redacted]

[redacted]

8th November 2014

FISH HEALTH EXAMINATION REPORT

Ref No : 14806

Sample & Source : 10 Carp (cnv) and 20 Rudd from Little Sea Lake, Studland, Dorset SZ 0300 8450

Examination Period : Submitted alive on 7th, examined on 8th November 14

Methodology : All fish were subject to a parasitilogical examination by dissection and microscopy.

Results : See separate table. The fish appeared in good condition with no lesions or abnormalities. Several common ectoparasites were found in low incidence/ very low intensity infections on the carp only; these being *Apisoma* sp (10%), *Trichodina* sp (30%) and *Dactylogyrus* sp (10%).
Internally 20% of the carp were carrying very low numbers of *Diplostomum spathaceum* and one rudd (5%) had a single plerocercoid of *Ligula intestinalis* in its body cavity.
The sample was aged 0+ - 3+ and of mixed sex but with only the older carp showing any discernible gonad development.

Conclusion : None of the common parasites found normally represent a health problem to prevent movement of the fish.

Declaration.

This health check is for the proposed movement of fish under Section 30 of the Salmon and Freshwater Fisheries Act 1975. It is therefore a statement of the current health status of the sample examined, and as such Thames Valley Aquatic Services accepts no liability whatsoever for any events which may occur after, and if , a consent to move the fish is approved.

[redacted]

Results Table : Fish Health Examination Report Ref No 14806

Fork Length (cm)	Weight (g)	Age	Sex	Skin	Gills	Internally
Carp (cnv)						
29.6	653.4	1+	-	-	-	-
29.9	625.5	1+	-	-	A	-
35.6	1009.3	2+	M	-	-	Ds
31.8	706.7	1+	-	T	D	-
37.4	1094.1	2+	F	-	-	Ds
32.1	781.9	1+	-	-	-	-
26.9	511.4	1+	-	-	-	-
54.1	2658.1	3+	F	-	T	-
52.5	2633.1	3+	F	-	-	-
53.2	2709.4	3+	M	-	T	-
Rudd						
6.4	3.0	0+	-	-	-	-
6.2	2.9	0+	-	-	-	-
6.6	3.3	0+	-	-	-	-
6.5	3.2	0+	-	-	-	-
7.3	4.8	0+	-	-	-	-
7.0	4.1	0+	-	-	-	Li
6.5	3.2	0+	-	-	-	-
6.5	3.2	0+	-	-	-	-
6.6	3.6	0+	-	-	-	-
6.4	3.0	0+	-	-	-	-
6.9	3.8	0+	-	-	-	-
6.4	3.0	0+	-	-	-	-
6.6	3.2	0+	-	-	-	-
6.7	3.6	0+	-	-	-	-
6.5	3.1	0+	-	-	-	-
7.2	4.8	0+	-	-	-	-
6.8	3.3	0+	-	-	-	-
7.0	4.2	0+	-	-	-	-
6.7	3.6	0+	-	-	-	-
6.4	2.9	0+	-	-	-	-

KEY : M = Male, F = Female, * = Moderate numbers, ** = High Numbers

T = Trichodina sp
A = Apisoma sp
D = Dactylogyrus sp
Ds = Diplostomum spathaceum
Li = Ligula intestinalis

[redacted]

Telephone : [redacted]

[redacted]

21st April 2015

FISH HEALTH EXAMINATION REPORT

Ref No : 15838

Sample & Source : 10 Carp (cnv) and 20 Rudd from Little Sea (EW069-G-816); POOLE; SZ03008450.

Examination Period : Submitted alive on 15th , examined 16th April 15

Methodology : All fish were subject to a parasitilogical examination by dissection and microscopy.

Results : See separate table. The fish appeared in good condition with no lesions or abnormalities. Two common ectoparasites were found on the fish; these being *Trichodina* sp (carp 60%) and *Dactylogyrus* sp (carp 50% rudd 15%). Internally 20% of the carp were found to have low intensity infections of *Diplostomum spathaceum* whilst 55% of the rudd had one or two plerocercoids of *Ligula intestinalis* in their body cavity. The carp were aged 4+ and of mixed sex with good gonad development whilst the rudd were 0+ with no discernible gonad development.

Conclusion : None of the common parasites found normally represent a health problem to prevent movement of the fish.

[redacted]

Results Table : Fish Health Examination Report Ref No 15838

Fork Length (cm)	Weight (g)	Age	Sex	Skin	Gills	Internally
Carp (cnv)						
54.6	3300.0	4+	M	T,D	-	-
56.0	4100.0	4+	M	D	-	-
53.1	3300.0	4+	F	-	-	-
54.2	3950.0	4+	F	T	-	Ds
56.2	3400.0	4+	M	T,D	T*	-
51.7	2650.0	4+	M	T,D	-	-
56.0	4500.0	4+	F	-	T	Ds
60.7	4650.0	4+	M	-	-	-
55.9	3600.0	4+	M	D	-	-
57.5	4100.0	4+	M	T	-	-
Rudd						
6.5	3.1	0+	-	-	-	L
6.8	3.7	0+	-	-	-	L
6.7	4.2	0+	-	-	-	L
7.0	3.8	0+	-	-	-	-
6.4	3.2	0+	-	-	-	L
7.0	3.8	0+	-	-	-	L
7.1	4.4	0+	-	-	-	L
6.5	3.2	0+	-	-	-	-
6.7	3.5	0+	-	-	-	L
6.5	3.2	0+	-	-	D	-
6.5	3.3	0+	-	-	-	L
6.6	3.4	0+	-	-	-	-
7.0	3.8	0+	-	-	D	L
6.7	3.4	0+	-	-	-	-
6.7	3.2	0+	-	-	-	L
7.0	3.5	0+	-	-	-	-
6.7	3.4	0+	-	-	D	-
6.4	2.9	0+	-	-	-	-
6.4	3.1	0+	-	-	-	L
6.6	3.4	0+	-	-	-	-

KEY : M = Male, F = Female, * = Moderate numbers, ** = High Numbers

T = Trichodina sp
D = Dactylogyrus sp
Ds = Diplostomum spathaceum
L = Ligula intestinalis

[redacted]

2nd June 2018

FISH HEALTH EXAMINATION REPORT

Ref No : 18973

Sample & Source : 20 Rudd and 10 Carp (cnv) from Studland (Little Sea) Poole. EW069-G-816. Map ref SZ03008450

Examination Period : Submitted alive on 23rd, examined 24th and 25th May 18

Methodology : All fish were subject to a parasitilogical examination by dissection and microscopy.

Results : See separate table. The fish appeared in good condition with no lesions or abnormalities. Several common ectoparasites were found in low intensity infections, these being *Trichodina* sp (rudd 5% cnv 90%), *Dactylogyrus* sp (rudd 55% cnv 10%) and *Echionochasmus* sp (rudd 95%). Internally 30% of the carp only were found to be carrying low numbers of *Diplostomum spathaceum*.
The sample was aged 1+ - 6+ and of mixed sex, all with developed gonads.

Conclusion : None of the common parasites found normally represent a health problem to prevent movement of the fish.

Declaration.
This health check is for the proposed movement of fish under Section 30 of the Salmon and Freshwater Fisheries Act 1975. It is therefore a statement of the current health status of the sample examined, and as such Thames Valley Aquatic Services accepts no liability whatsoever for any events which may occur after, and if , a consent to move the fish is approved.

[redacted]

Fork Length (cm)	Weight (g)	Age	Sex	Skin	Gills	Internally
Rudd						
16.5	76.4	3+	F	E	*D,T	-
16.1	72.0	3+	F	E	D	-
15.4	70.9	3+	F	E	-	-
15.2	68.1	3+	F	E	-	-
15.1	63.3	3+	F	E	-	-
10.3	16.6	1+	F	E	D	-
10.4	18.0	1+	F	E	-	-
9.9	17.3	1+	M	-	-	-
11.3	23.9	1+	F	E	D	-
9.6	14.8	1+	M	E	D	-
11.5	25.6	1+	F	E	D	-
12.8	34.9	2+	F	E	D	-
11.0	21.8	1+	M	E	D	-
12.2	29.3	1+	F	E	-	-
14.1	45.5	2+	M	E	D	-
11.6	24.0	1+	F	E	D	-
12.1	27.8	1+	F	E	-	-
10.5	20.6	1+	F	E	-	-
10.8	20.3	1+	F	E	-	-
10.4	20.1	1+	F	E	D	-
Carp (cnv)						
57.1	3950.0	6+	M	T	T	-
56.0	3400.0	5+	M	T	T	-
54.6	3350.0	5+	M	-	T	Ds
51.8	2400.0	5+	M	-	T	-
54.2	2850.0	5+	M	T	T	-
52.5	3350.0	5+	F	-	-	Ds
54.6	3150.0	5+	M	-	T	Ds
47.6	2400.0	2+	M	T	T,D	-
56.5	3500.0	5+	M	-	T	-
55.0	4250.0	5+	F	T	T	-

KEY : M = Male, F = Female, * = Moderate numbers, ** = High Numbers

T = Trichodina sp
D = Dactylogyrus sp
E = Echionochasmus sp
Ds = Diplostomum spathaceum

5.0 Discussion of data collated

5.1 Number of fish removed

The number and weight of carp removed declined steadily from 2014-2019. As the report details, the methodology also changed over this period, with efficiency of capture improving over time.

The Covid pandemic forced a year's break in 2020. Captures in 2021were noticeably higher than in 2019, with respect to both weight and number of carp. This trend continued into 2022 with a further increase in weight and number of fish removed.

Some of this can be attributed to lack of fishing effort in 2020 allowing carp to recruit and grow with no cropping of stock. There are other factors that may also have contributed to the increased catch; 2021 was the year with the largest number and weight of fish removed since commencement in 2014. The low water levels in 2022 forced carp away from marginal areas which previously provided them with shelter. This made them more vulnerable to capture in the open water areas, with multiple fish often caught in individual settings of the nets.

The percentage of mirror carp captured also increased. Mirror carp are a recessive type, with the fully scaled common carp the dominant variety over time. Such an increase in mirror carp is thus very likely to be attributable to introduction of more carp of this type. There is therefore a strong suggestion that the carp in Little Sea have come from more than one stocking of fish. This multiple stocking theory is further supported by the presence of a number of other varieties of carp, including some with strong koi carp influence and at least one strain with clear linkage to goldfish antecedents. The presence of increased number of mirror carp could go some way to explaining the large rise in the overall carp catch post 2020.

5.2 Individual fish weights

The methodologies employed to remove carp at Little Sea (trammel netting, gill netting and electrofishing) are size selective. The mesh sizes used for the netting are too large to capture any carp <0.25kg, with these smaller fish only susceptible to capture by electrofishing in marginal areas. This selectivity probably explains the relative dearth of fish <0.25 kg, with the 0.5kg-1kg size class the smallest that was susceptible to capture in the gill/trammel nets.

Fish in the 2kg - 4kg size range are strongly represented in the consolidated catch, with individual fish in excess of 9kg having been caught.

5.3 Age of carp

If the hypothesis of multiple introductions of carp into Little Sea is accepted then the early years history of some of the stock may relate to their previous habitat. Subject to that caveat, Little Sea carp grow reasonably quickly, with fish reaching >9kg within 9 years. The shallow nature and generally warm temperature of the lake allow for moderate/fast summer growth. As the standing crop of carp has been reduced, the food availability for individual fish has probably increased, with reduced competition between individual fish for food.

5.4 Fish health

Multiple fish examinations have failed to reveal any notifiable (to the Environment Agency) internal or external parasites. The health of all fish examined has been good, with no evidence of any damaging impact of parasites on individual fish. Note no examination is routinely undertaken for fungal, bacterial or viral diseases of fish.

Examination of the carp suggested that sexual maturity was generally achieved at 3-4 years of age, with most fish greater than 4 years of age having well developed gonads. This fact has obvious implications for recruitment of carp to the fishery; removal of fish before the age of 3 will largely prevent their opportunity to add to the population.

6.0 The Future

The present management policy of regular capture and removal of carp from Little Sea has the potential to reduce the overall standing crop enough to allow for the regeneration of submerged vegetation, with the caveat that all external sources of nutrients, particularly phosphorus are adequately controlled.

However, if this management ceases then there is a strong likelihood that the population will simply expand to pre-removal levels. There is clear evidence of regular recruitment of carp to the fishery with fish health examination suggesting that spawning will occur in the third or fourth year of the carps' life.

The empirical evidence of multiple illegal stocking of the lake (the sudden appearance of a cohort of previously under-represented mirror carp) presents another challenge to removal of carp from the lake. Given the size of Little Sea it is very hard to see how the future illegal stocking of carp could ever be practically prevented.

A range of other more radical options for carp removal is being considered by the Little Sea management group. To date however none of these have passed the twin tests of practicality and acceptability.