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White-clawed Crayfish and Lesser Bearded Stoneworts in the Lower Windrush Valley (Oxfordshire)

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1. Introduction

1.1 Aims and objectives

Two UK Biodiversity Action Plan (BAP) priority species were recorded in three lakes during a baseline assessment of 40 gravel pit lakes in the Lower Windrush Valley in 2004 (Pond Conservation, 2005). White-clawed Crayfish (*Austropotamobius pallipes*) was recorded in Downs Road Trout Lake, Lesser Bearded Stonewort (*Chara curta*) in Darlow Water and Unity Lake (Figure 1 and 2).

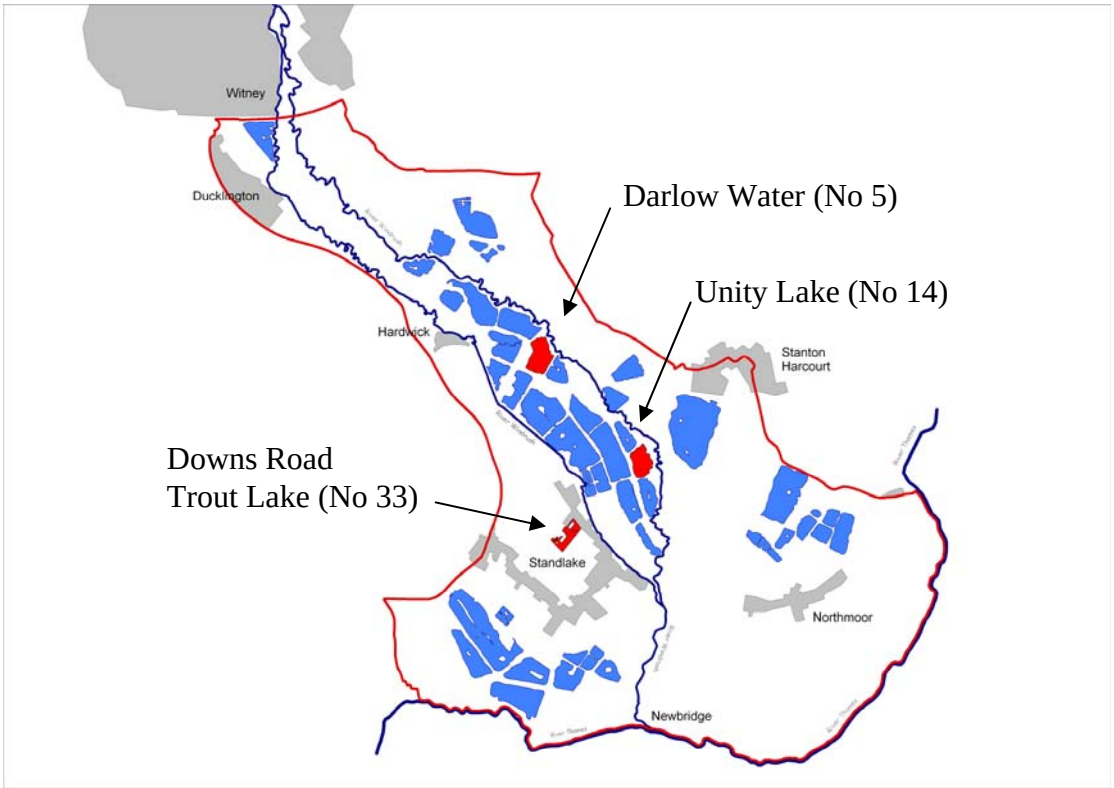


Figure 1 The Lower Windrush Valley Project area (red outline), showing Darlow Water, Unity Lake and Downs Road Trout Lake

The main aim of the current project was to undertake work that would help to maintain and enhance sustainable populations of both species. Specifically, our objectives were to assess, for both species:

- The population size in known lakes and surrounding freshwater habitats.
- The potential impact (both negative and positive) of the current lake management practices, based on discussions with fishery managers and anglers.
- The potential for habitat creation and translocation, based on (i) information gathered in the previous and current surveys, (ii) consultation with specialists for both species.

In the longer term, the overall aim is to achieve consensus between stakeholders so that BAP species are protected, whilst maintaining fishing activities at the lakes.

1.2 UK BAP context

The project consolidates the positive biodiversity gains arising from aggregate extraction in the Lower Windrush Valley (LWV) and supports the delivery of the following BAP targets:

- National Species Action Plans (SAPs) for White-clawed Crayfish and Lesser Bearded Stonewort[1]. Both SAPs include actions relating to monitoring, appropriate site management, assessing reintroduction to suitable habitat near existing populations and advising landowners and managers.
- Oxon HAP for gravel pit lakes for which Alison Hopewell of the LWV is the lead partner. This HAP has objectives for BAP species including research, monitoring, habitat management and creation, advice to planning officers and landowners and raising awareness amongst the wider community.

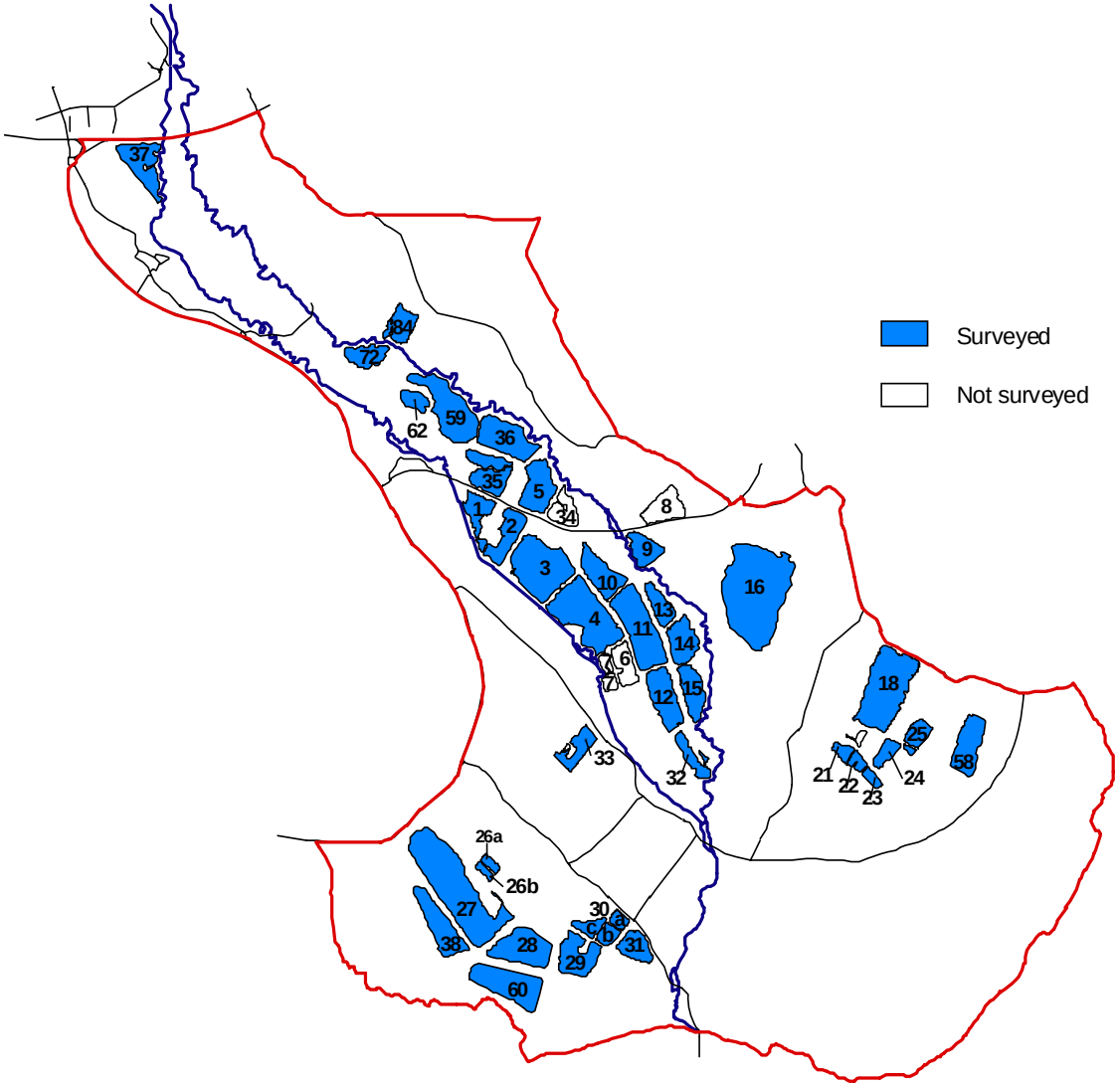
The results of the current project will also feed into the development of a freshwater biodiversity strategy for the LWV (Pond Conservation, 2008).

1.3 The Lower Windrush Valley (LWV)

The Lower Windrush Valley (LWV), in West Oxfordshire, is an area that incorporates the floodplain of the River Windrush from the town of Witney to its confluence with the River Thames at Newbridge. Over the last 60 years, the valley has been extensively modified by mineral extraction, with large areas of the riverside pasture transformed into a mosaic of open water. In 2004, there were 45 lakes in the valley that had been created through the restoration of gravel pits (Figure 2). These comprise a total of c.357 ha of standing open water. This area continues to increase each year with approximately 17 lakes approved within current planning permissions for future mineral extraction in the valley.

The Lower Windrush Valley Project (LWVP), which covers an area of some 28 km^2, was established by Oxfordshire County Council to create and implement an environmental strategy for this area. Officially launched in 2001, the project works closely with mineral operators, landowners and the local community to co-ordinate, implement and help manage a range of initiatives that aim to strengthen the landscape, protect and enhance the biodiversity and improve public access in the valley.

[1] Lesser Bearded Stonewort was removed from the list of BAP species in summer 2007.



Lower Windrush Valley Gravel Pits

01 - Manor Farm Lake
02 - St John's Lake
03 - Hardwick Leisure Park 1
04 - Hardwick Leisure Park 2
05 - Darlow Water
06 - Newlands Specimen Lake
07 - Newlands Surman Lake / Bents Pool
08 - Vicarage Pit
09 - Vauxhall Lake
10 - West Oxon Sailing Club 1
11 - West Oxon Sailing Club 2
12 - Oxlease Lake
13 - Yeomans Lake
14 - Unity Lake
15 - Gaunt Lake
16 - Dix Pit
18 - Stoneacres Lake
19 - Linch Hill Silt Ponds
21 - Linch Hill complex 3
22 - Linch Hill complex 4
23 - Linch Hill complex 5
24 - Willow Pool
25 - Christchurch Lake
26 - Lincoln Lake
27 - Three T's Lake
28 - Windsurfing Lake
29 - Standlake Common 1
30 - Standlake Common 2
31 - Barnes Lake
32 - Hunts Corner
33 - Downs Road Trout Lake
34 - States Lagoon
35 - Smiths Pool / Hardwick Lake
36 - Brasenose Lake
37 - Witney Lake
38 - Shifford Lake
58 - Watkins Farm
59 - Gill Mill Lake
60 - Standlake Common Nature Reserve
62 - Founders Lake
72 - Graham Water
84 - Claire Lake

Figure 2 Gravel pit lakes included in the 2004 baseline assessment

2. White-clawed Crayfish at Downs Road Trout Lake

2.1 Species overview

White-clawed Crayfish (*Austropotamobius pallipes*) is the only crayfish species native to the UK. It occurs in clean calcareous streams, rivers and lakes, including gravel pit lakes.

White-clawed Crayfish is listed in Appendix III of the Bern Convention and Annexes II and V of the EC Habitats Directive. It is classed as Globally Threatened by IUCN/WCMC and it is protected under Schedule 5 of the WCA (For White-clawed Crayfish SAP, see www.ukbap.org.uk)

The species has declined dramatically ever since the American Signal Crayfish (*Pacifastacus leniusculus*) and other Non-Indigenous Crayfish Species (NICS) were introduced into the UK in the 1970s. The causes of declines include:

- Crayfish plague, a disease caused by the fungus *Aphonomyces astaci*, which is carried by some North American Crayfish, including the Signal Crayfish. Spores of the fungi can be transmitted between waterbodies on wet fishing gear and other damp equipment.
- Direct competition for food and habitat from non-native crayfish, including Signal Crayfish.
- Habitat modification and management of waterbodies.
- Pollution, particularly pesticides and organic enrichment.

2.2 White-clawed Crayfish status in the LWV

In the LWV, White-clawed crayfish has almost completely disappeared. In fact, it now only remains in very few places in Oxfordshire (Figure 3). It was, therefore, surprising to record it at Downs Road Trout Lake in 2004, as part of a survey of aquatic plant and macroinvertebrates in 40 gravel pit lakes (Pond Conservation, 2005). This site is now almost certainly the only waterbody where native crayfish still survive in the whole of the LWV.

White-clawed Crayfish were introduced into the lake in the 1960s from the Windrush (Malcolm Jones, the Fishery Officer, pers. comm.). The two main reasons native crayfish still occurs at this site are likely to be:

- The lake has no connection with other waterbodies, and is outside the floodplain of the River Windrush. This was confirmed by the fact that the site was not flooded in the summer of 2007, in a one in 100 year flood event.
- The lake is fished for trout by club members from the Abingdon and Oxford Anglers Alliance (Trout Section) at relatively low intensity. Very little fishing takes place during the summer, when the temperature of the water and the lake turbidity increases. The club is not run as a commercial fishery, and club members are mostly local residents who are keen to maintain the biodiversity interest of the lake.

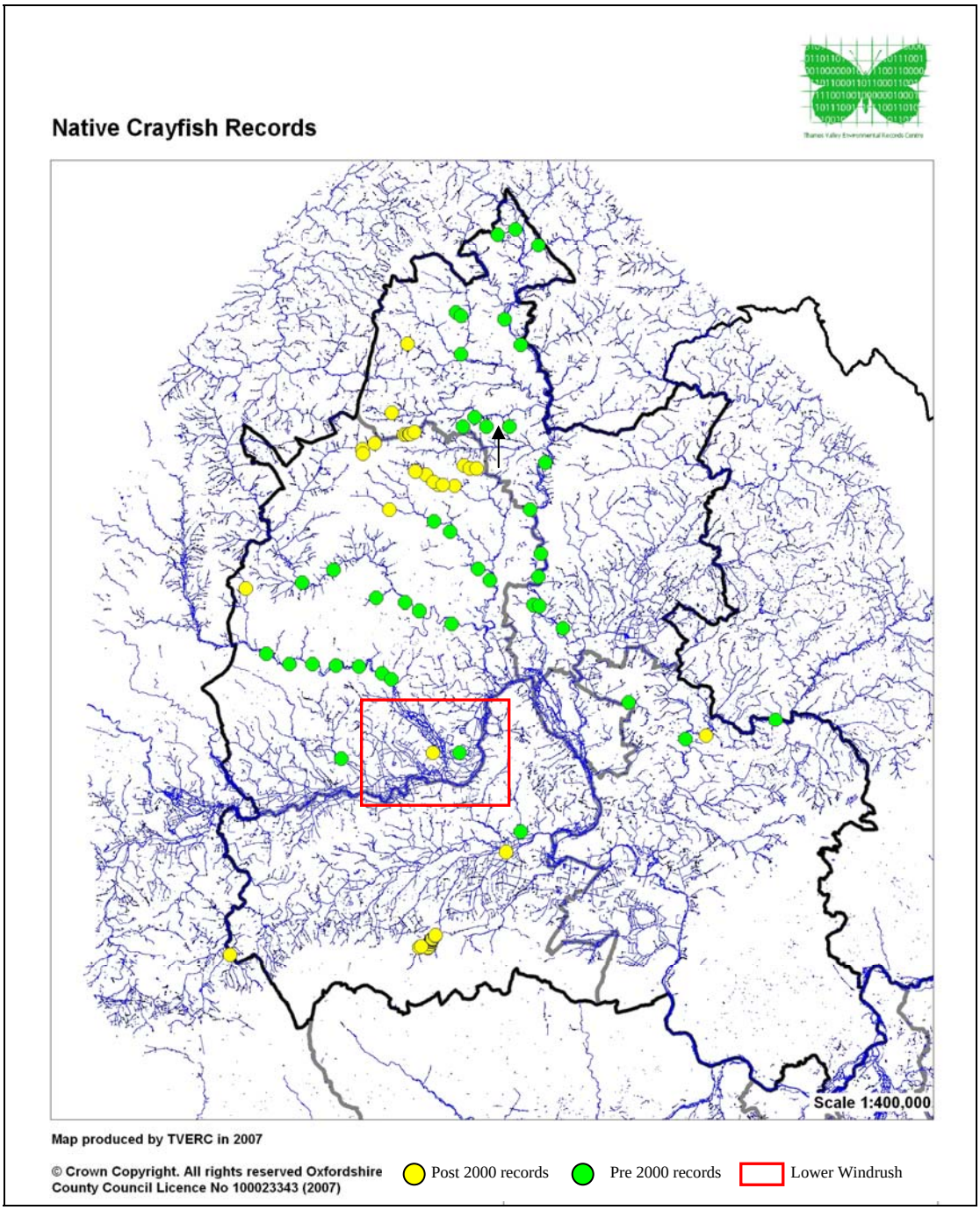


Figure 3 White-clawed Crayfish in Oxfordshire

The White-clawed Crayfish at Downs Road Trout Lake are important in that they may provide a source for reintroduction into other waterbodies in the LWV. Opportunities are likely to occur in rivers and streams only if non-native species are eradicated. However, other gravel pit lakes outside of the floodplain have the potential to provide Arksites and contribute to the survival of the species in this area.

2.3 Downs Road Trout Lake: background

2.3.1 Site description

Downs Road Trout Lake (gravel pit lake No 33) was dug after the Second World War by a local aggregate extraction company. The Abingdon and Oxford Alliance has managed the trout fishery, called Martins Lane Fishery, since 1966. Information about the site was collected from discussions with Malcolm Jones, Fishery Manager.

The lake is on a site quite separate from the other lakes in the LWV. It is overlooked by houses on Downs Road, with their gardens forming the northern boundary. Martins Lane runs along the north-west boundary, screened by mature trees, and a narrow belt of trees forms a hedge at the boundary with arable land to the south and east. The site also has two ponds: a small circular pond which was one of the original trial holes dug prior to gravel extraction, and a larger pond originally used as a trout nursery (see Appendix 1.1 for a map of the site).

The banks of the main lake are generally steep with few shallow water areas. As a result, the emergent stands of vegetation are quite narrow, particularly on the south-east side. There are more developed vegetation stands in a relatively shallow 'swamp' on the north and north-west side, and a shaded area on the south-east side. The lake has a number of islands: the larger ones were created from the topsoil removed when the site was quarried, and the smaller ones are natural sandstone bars.

The lake is stocked periodically with rainbow trout throughout spring, no feed is added. The club observes a closed season over the winter and the lake opens to members in March. Management of the lake margins is carried out in winter by work parties composed of club members (three work parties every year). The main aim of management is to keep the fishing pegs open, and maintain the diversity of habitats by removing encroaching trees and scrub. Large flocks of geese can be an issue at the site.

Alison Hopewell of the Lower Windrush Valley Project and Pascale Nicolet of Pond Conservation attended one of the work parties to discuss the results of the survey with club members.

2.3.2 Wetland plant and macroinvertebrate diversity: results from other surveys

During the summer 2004 survey, the lake was found to be of low value for wetland plants and of high value for macroinvertebrates compared to other lakes in the LWV. A total of 67 macroinvertebrate and 26 wetland plant species were recorded in the gravel pit lake. The relatively low conservation value for wetland plants is likely to be related to (i) the lake's relatively steep margins and bank shade, which limit the development of marginal plant, and (ii) its small size compared to other lakes in the LWV.

Discussion with the Fishery Manager recently revealed that the lake bottom is very uneven because the lake was excavated wet, using a drag line technique. A boat survey in early summer, before the turbidity of the water increases, might reveal the presence of other submerged plants, including stoneworts, on the shoals and other ridges in the middle of the lake.

The old stock pond was surveyed for wetland plants and macroinvertebrates in summer 2007 as part of a survey of 15 ponds in the LWV (Pond Conservation, 2008). The results of the survey show that the pond is a Priority Pond under the UK BAP with a PSYM score of over 75% (Pond HAP criteria 4). A total of 30 macroinvertebrate species and 20 wetland plant species were recorded, bringing the total species richness for the site as a whole to 79 macroinvertebrate and 34 wetland plant species.

White-clawed crayfish is the only important species of conservation concern that has been recorded at the site. Two individuals were recorded in the northern corner of the site in 2004 (see location in Appendix 1.1). Two Nationally Scarce species of water beetle occur at the site: *Anacaena bipustulata* in the lake and *Ilybius fenestratus* in the pond.

2.4 Crayfish survey methods

The objective of the 2007 survey was to assess the White-clawed crayfish population size at Downs Road Trout Lake by using a mark and recapture technique.

The trapping method used in this survey was the same as that used in the 2004 baseline survey (Pond Conservation, 2005). The water vole-friendly traps were supplied in 2004 by David Rogers, the lead partner for the White-clawed Crayfish Species Action Plan. A licence to trap was obtained from Natural England (Licence number: 20072249) and the traps were licensed by the Environment Agency (TEA04379A).

A total of 40 traps were deployed in suitable habitats, such as stands of marginal vegetation, under overhanging trees and amongst tree roots. The traps were baited with smoked fish and checked every 24 hours over 5 days (4 nights) from 13 to 17 August 2007 by Pascale Nicolet with the help of other Pond Conservation staff (Anita Weatherby and Ruth Welters).

Four baited traps were also laid in Downs Road stock pond overnight (22 to 23 August 2007) as part of the survey of 15 ponds in the LWV (Environment Agency consent TEA02659A).

2.5 White-clawed Crayfish survey at Downs Road Trout Lake: results

One White-clawed Crayfish individual was recorded from Downs Road Trout Lake during this survey, under a fishing peg, in a different location to where the species was previously recorded (see Appendix 1.1). No crayfish were caught in the stock pond. No evidence of other crayfish species was observed during the survey.

The results of the survey suggest that the lake may be supporting a very small, patchily distributed population of White-clawed Crayfish. However, surveying for crayfish in lakes is notably difficult. Another technique, such as night torching in the shallows from a boat may need to be used to further investigate the native crayfish population distribution and density.

2.6 Ecological assessment

The results of the 2004 and 2007 crayfish surveys suggest that the Downs Road Trout Lake supports a low density of White-clawed Crayfish. No evidence of breeding was recorded from the three individuals caught in the two surveys, so it is unclear whether the lake currently supports a breeding native crayfish population.

The suitability of Downs Road Trout Lake can be assessed against the basic requirements of the White-clawed Crayfish:

- *Suitable habitat for refuges:* These are needed for crayfish of all ages but particularly juveniles, which are especially vulnerable to predation by a range of animals including other invertebrates (including mature crayfish), birds, fish and mammals. Downs Road Trout Lake has a wide range of potential refuges for White-clawed Crayfish, particularly submerged tree roots, overhanging trees or branches, leaf packs and steep or vertical earth banks. The management of marginal habitats to maintain open areas suitable for angling is not currently an issue because it is carried out at a low intensity.
- *Food supply*: White-clawed Crayfish feed on leaf and plant litter, aquatic macrophytes, aquatic invertebrates, dead animal remains and small live fish. All of these are present at the lake and this is unlikely to be a limiting factor.
- *Access to other crayfish for breeding*: The lake is isolated from other standing waterbodies and the present population at the lake has developed from a small number of individuals (‘2-3 buckets full’) over a 40 year period. The small size of the original population may be a limiting factor and population growth can be particularly slow in sub-optimal conditions (Paul Bradley, pers. comm.).
- *Suitable water quality*: The lake is very clear during the winter months but becomes turbid from late spring and through the summer. This may be an issue for the White-clawed Crayfish if it results in low dissolved oxygen concentrations. The lake may not have a good through flow of groundwater, which would maintain good water quality. This may be partly because of self-sealing or because the gravel reserves that were extracted from this site were isolated pockets surrounded by clay. In addition, the lake is bordered on two sides by arable land, which may contribute to nutrient enrichment of the lake.
- *Freedom from contamination by crayfish plague or alien crayfish*. This is a risk to the White-clawed Crayfish population at Downs Road Trout Lake, particularly since other fished waters in the area have Signal Crayfish populations. The gear (rod, net etc) of anglers who fish more than one waterbody over a short time period can carry the plague or even juvenile Signal Crayfish. However, the risk is relatively low at this site because of the low intensity of fishing. Of more concern is the introduction of fish stocks reared in potentially contaminated waters.

Further information is required to try and assess crayfish density at the site, and whether the population is breeding. Based on the information currently available, the main limiting factor on the White-clawed crayfish population at Downs Road Trout Lake would seem to be related to its isolation from other White-clawed Crayfish population and, potentially, water quality. In addition, the population is potentially at risk from contamination by NICS or the crayfish plague.

2.7 Potential for habitat creation and translocation

The potential for conservation action both at Downs Road and in the wider regional context was assessed using preliminary guidance on conservation action for the White-clawed Crayfish (Berry, 2007) and available information about the site and its surroundings.

Creation of additional habitats for White-clawed Crayfish in the vicinity of the Downs Road Trout Lake is not an option because of the current land use and the presence of Signal Crayfish in many waterbodies in the LWV. The potential for using newly restored gravel pit lakes located outside of the River Windrush and Thames floodplains as Arksites is being considered as part of the development of a freshwater biodiversity strategy for the Lower Windrush Valley as a whole.

Based on the information available, which suggest that the White-clawed Crayfish is present at Downs Road Trout Lake at low density, there is currently little potential for translocating White-clawed Crayfish individuals from this site to other, potentially more suitable, waterbodies in the LWV.

2.8 Recommendations

The main recommendations that can be made based on the results of this study are:

- *Survey and monitoring*: Surveys using techniques such as night torching and refuge traps should be used to gain further information on the distribution and density of the White-clawed Crayfish population at Downs Road Trout Lake, and to establish whether the population is breeding successfully. Water chemistry, and in particular the dissolved oxygen content in various parts of the lake should also be investigated.
- *Minimise the risk of Non-Indigenous Crayfish Species (NICS) and disease introduction*: A short article on the importance of the site for White-clawed Crayfish has already been sent to all club members with their annual newsletter (Appendix 1.2). Further information should be posted in the clubhouse, subject to approval by the Fishery Manager (e.g. the Environment Agency's Crayfish Code). The source of the fish stock should also be reviewed to assess the risk posed to the native crayfish population.

3. Lesser Bearded Stonewort

3.1 Species overview

Lesser Bearded Stonewort (*Chara curta*) is a species of calcareous water, and is found in a wide range of waterbodies, including gravel pit lakes, ponds, flooded dune slacks, limestone lochs, and clay pits and more rarely old peat cuttings and ditches. The most significant threat to the species is nutrient enrichment from agricultural run-off, and shade from scrub and other vegetation.

In gravel pit lakes, Lesser Bearded Stonewort occurs almost anywhere and at any depth. It can persist in deeper water over long periods of time if good water quality is maintained and the stonewort community is well established, reducing competitive effects from other submerged species such as *Elodea*. In mature gravel pit lakes, which are more likely to be enriched, species such as *Elodea* tend to become dominant in deeper water, restricting Lesser Bearded Stoneworts to shallow water.

Lesser Bearded Stonewort is classified as Nationally Scarce in Great Britain and was listed as a BAP species until 2007. The UK supports 40-50% of the world population of this species, however, because of a change in criteria[2], the species is no longer considered sufficiently rare to merit priority status in the UK (Nick Stewart, pers. comm.).

Lesser Bearded Stonewort was recorded from two lakes in the 2004 baseline assessment of 40 gravel pit lakes in the LWV (Pond Conservation, 2005): Darlow Water and Unity Lake. The species had not been recorded previously in Oxfordshire.

3.2 Survey methods

The lakes surveyed for Lesser Bearded Stonewort included Darlow Water and all three Guy Lakes (Unity, Yeomans and Gaunt), and a number of other lakes and ponds in the LWV. All survey work was carried out by Nick Stewart, the national referee for stoneworts, from 11 to 13 September 2007.

Shallow water areas were surveyed by walking and wading, particularly from open bays and pegs. Deeper areas were surveyed by using a grapnel and an underwater viewer. A boat was used at Darlow Water so that the shoals and ridges on the lake bottom, which are often favoured by stoneworts because they stay relatively free of organic sediments, could be surveyed.

[2] The species would now have to be endemic to the UK to remain on the BAP list. The UK has >20% of the world population of Lesser Bearded Stonewort.

3.3 Darlow Water

3.3.1 Site description

Darlow Water (gravel pit lake No 5) is a trout fishing lake managed by the Farmoor Flyfishing Club. Information about the site was collected at meetings and in discussions with club committee members, in particular Brian Holloway and Wally Ward. The club was set up 22 years ago and now has 250 members.

Darlow Water is a 9ha lake bordered by the River Windrush on its North east boundary, the Standlake Brook on it western boundary, and the B4449 to the south (see Appendix 2.1 for a map of the site). The Lake to the north, Brasenose Lake (No 36) is part of the Linear Fisheries lake complex which includes all the lakes in the vicinity of Darlow Water (Figure 1).

Darlow Water has a narrow band of emergent vegetation, mainly sedges and rushes, around its margins, interspersed with open patches created by the fishing pegs. The lake margins grade into areas of shallow water mainly colonised by stonewort, which grow in extensive 'lawns'. Deeper water areas are dominated by *Elodea* species (both Canadian and Nuttall's Waterweed are present at the site).

Following widespread flooding in summer 2007 the club had problems with algal blooms, probably due to input of nutrient-rich water from both upstream lakes and the Standlake Brook. The old course of this brook used to run through the land where Darlow Water now stands prior to the gravel being extracted, and it tends to continue on its original path at times of flooding.

Fish parasites have also been a problem in the lake, particularly since the 2007 flooding, and the lake is now stocked with trout treated to remove parasites and other diseases. In addition, trout are now released into the lake more often but in smaller quantities to help maintain a healthy stock. Feeding takes place in winter to relieve the pressure on invertebrate food. A number of carp from Brasenose Lake entered Darlow Water during the 2007 flooding and the club is looking at options to remove them.

Members manage the lake margins twice a year by mowing, leaving a 1m margin around the lake to encourage the insect population. Ground baiting and wading is not allowed. *Elodea* management is an issue, particularly because it forms rafts of floating vegetation which impede fishing activities and this species is currently removed by hand.

3.3.2 Wetland plant and macroinvertebrate diversity: results from other surveys

The 2004 survey of gravel pits in the LWV, showed that Darlow Water had a Very High conservation value for wetland plants (45 species) and a High conservation value for macroinvertebrates (59 species) compared to other lakes in the LWV. Two Nationally Scarce species of water beetle were recorded in the survey (*Ilybius fenestratus* and *Anacaena bipustulata*), as well as the Nationally Scarce Lesser Bearded Stonewort.

Two invasive species were also recorded in the lake. Signal Crayfish are trapped by the members of the fishing club under licence from the Environment Agency and are removed in their thousands every year. Australian Swamp Stonecrop (*Crassula helmsii*) is present in extensive patches along the lake margins, particularly on the western side of the lake, which is the most used by anglers.

A small (less than $30m^2$) temporary pond dug in the northern margin of the lake as compensation for building the club house on the floodplain was also surveyed as part of a companion project in summer 2007 (Pond Conservation, 2008). The pond supported 36 species of invertebrates, including three Nationally Scarce water beetle species, one of which was not recorded in the 2004 survey (*Rhantus suturalis*, the other species were *Hydroglyphus geminus* and *Berosus affinis*).

Overall the site as a whole supports 47 species of wetland plants and 95 species of macroinvertebrates. A total of five Nationally Scarce water beetle species have now been recorded at the site. The site is particularly diverse for stoneworts, with a total of five species recorded: four species from the lake and another species from the temporary pond.

3.3.3 Lesser Bearded Stonewort survey results

Lesser Bearded Stonewort was found in small patches in the shallows on the eastern side and western side of the lake (Appendix 2.1). It was not possible to measure the true extent of this species beyond this, because Lesser Bearded Stonewort occurred in mixed 'stonewort lawns' with the taxonomically similar Rough Stonewort (*Chara aspera*). Shallow areas with stonewort lawns were generally dominated by Rough Stonewort, and small patches of Lesser Bearded Stonewort could easily have been missed. This was made worst by the poor conditions of the plants due to summer floods, including a layer of silt and turbidity effects.

The most exciting result of the survey was the discovery of another stonewort species, Starry Stonewort (*Nitellopsis obtusa*), at Darlow Water. This species was found on a ridge at the northern end of the lake (Appendix 2.1). Starry Stonewort is classified as a Red Data Book Vulnerable and BAP species, and this is the first record for Oxfordshire.

3.3.4 Ecological assessment

Longer term monitoring of the Lesser Bearded Stonewort population at Darlow Water is needed in order to help further assess the extent of the species, and whether it is stable. The presence of Starry Stonewort reinforces the importance of maintaining good conditions for stoneworts in the lake in the long term. The current management of the lake margin for fly fishing is beneficial for stonewort stands by reducing tree and scrub growth which might otherwise create shade over shallow water areas where Lesser Bearded Stonewort is restricted.

Based on the information available, the main issues for Lesser Bearded Stonewort and other stonewort species at Darlow Water are:

- *Water quality*: Nutrient enrichment impacts on sensitive species like stoneworts, giving a competitive advantage to species like *Elodea*, should be avoided at the

site. This is particularly an issue with reference to floodwater from intensive coarse fishery lakes and the Standlake Brook, but the input of fish feed may also contribute to overall nutrient levels in the lake.

- *Competition from Australian Swamp Stonecrop*: This species is very difficult to control and is already established around much of the lake margin, particularly on the western side. Further expansion may have an impact on stoneworts, particularly on the shallow water Lesser Bearded/Rough Stonewort lawns. Activities associated with fishing the lake, such as clearing pegs and moving between pegs is very likely to help the species spread.

3.3.5 Recommendations

Based on the results of this and previous surveys, a number of recommendations can be made to help maintain populations of Lesser Bearded Stonewort and Starry Stonewort at Darlow Water:

- *Biological survey and monitoring*: Both rare stonewort species should be monitored annually to better understand their distribution and to act as an early warning system in case the population declines.
- *Maintain water quality*: Options to reduce the input of nutrients to the lake in times of flood should be explored with other stakeholders, including the Environment Agency, which are responsible for the management of the Standlake Brook.
- *Control the spread of Australian Swamp Stonecrop*: As part of the current project, a leaflet has already been produced for members to make them aware of how they might help prevent the spread of this species around the lake and, more importantly, to other sites (Appendix 2.3). Other options, including the use of pesticides, could be explored, but needs to be undertaken in conjunction with experts (e.g. CEH's Centre for Aquatic Plant Management, CAPM), and take into account the potential impacts on stoneworts.

3.4 Unity Lake

3.4.1 Site description

Unity lake (gravel pit lake No 14) is managed as a coarse fishery by a commercial organisation, Linear Fisheries, which is a subsidiary of the aggregate extraction company Smiths and Sons (Bletchington) Ltd. Information about the lake was collected from meetings and discussions with Andrew Smith, the Managing Director of Linear Fisheries, and Chris Blunt, the Fishery Officer.

Access to the lake is restricted to members of the Guy Lakes syndicate, which also includes Yeomans Lake (pit 13) to the north and Gaunt Lake pit 15 to the south (see Appendix 2.2). The River Windrush flows along the east boundary of the site. The Medley Brook separates Guy Lakes from other Linear Fisheries lakes to the west.

The lake is generally shaded by mature trees but the margin supports relatively well developed emergent vegetation stands, including reeds, rushes and sedges, interspersed with fishing bays and pegs. In the 2004 survey, deeper areas were mainly colonised by Nuttall's waterweed, which formed extensive stands, with smaller patches of stonewort in the shallows. Lake turbidity was relatively high which suggested that water quality might be an issue.

The management of the lake includes maintaining the lake margins for angling. The grass surrounding the lake is kept short by mowing and all three Guy Lakes generally have a 'well kept' appearance. Unity Lake was last stocked with fish in winter 2004 and stocking densities have been relatively stable over the past few years. A small number of Grass Carp are present in the lake.

Herbicides are used most years to control submerged plants, particularly *Elodea* species (both Nuttall's and Canadian Waterweed are present). Midstream GSR has recently replaced the previously used Claracin. Herbicide use aims to keep clear areas for anglers and is confined to historic problem areas. Herbicides are not applied within 5m of the lake margin.

3.4.2 Wetland plant and macroinvertebrate diversity: results from other surveys

The 2004 survey showed that, compared to other lakes in the LWV, Unity Lake was of High conservation value for wetland plants (38 species) and Moderate conservation value for macroinvertebrates (57 species). The only uncommon species recorded at the lake was the Nationally Scarce Lesser Bearded Stonewort.

The diverse plant community is likely to be a result of the management of the lake margin for angling which keeps pegs and fishing bays open.

3.4.3 Lesser Bearded Stonewort survey results

Lesser Bearded Stonewort was not recorded in any of the three Guy Lakes in 2007, including Unity Lake where it was previously recorded. In fact, few submerged plants were found in any of the three lakes in the current survey. The most abundant patches of stonewort were found in Yeomans Lake, (particularly in the shallow water on the western side of the lake), but Lesser Bearded Stonewort was not recorded. Gaunt Lake

was the most turbid of the three lakes and supported very small patches of stoneworts in the eastern side of the lake. No stoneworts were recorded in Unity Lake.

3.4.4 Ecological assessment

All three Guys Lakes had a very low abundance of submerged plants. This is in sharp contrast to the results of the 2004 survey, when all three lakes supported extensive stands of *Elodea*, with small patches of stoneworts. The cause of this decline cannot be explained at this time. However, a number of factors, singly or in combination may have contributed:

- *Unsuitable habitat*: The relatively poor water quality of coarse fishery lakes, together with the disturbance caused by bottom feeding fish species can lead to a loss of sensitive submerged plants such as stoneworts. However, this cannot explain the seemingly complete loss of *Elodea* in Unity Lake, which can thrive in eutrophic, disturbed conditions.
- *2007 flooding*: The input of floodwater rich in nutrients is likely to have caused an impact on water quality, with a potential knock-on effect on submerged plant stands. The higher than normal water levels throughout 2007, together with high nutrient levels may also have reduced the depth of the euphotic zone (where light penetration is sufficient to allow photosynthesis), limiting plant germination and growth.
- *Herbicide use*: This is aimed at nuisance species such as *Elodea*, however herbicides will also eliminate more sensitive native species, including stoneworts. This is unfortunate because (i) stonewort species, known as 'onion weed' by anglers, provide particularly good feeding grounds for fish, (ii) stoneworts, which grow in short 'lawns' like Lesser Bearded Stoneworts, do not cause the same entanglement problems as *Elodea* species, and (iii) eliminating stoneworts and other native plants, leaves room for further growth of *Elodea* – exacerbating problems with this alien species in the long term. Herbicide use is a management practice which has been relatively constant for a number of years, and the lakes are not treated in their entirety. It seems therefore unlikely that this factor *alone* would cause the almost complete loss of submerged plants at Unity Lake.

3.4.5 Recommendations

Further information is needed to assess whether the decline of the submerged plant community in the three lakes was due to natural variation following the 2007 flood event, or if the lakes are becoming degraded more generally. This is particularly important in Unity Lake because of the presence of Lesser Bearded Stonewort at the site.

Closer monitoring of the variation in the plant community throughout the year and following management activities would help better understand these results. Ideally, since all three lakes are relatively similar in age and support similar plant communities, each lake could be managed in a different way so that the effects of coarse fishery management on biodiversity become more evident, to the benefit of both. Waterbodies with poor water quality tend to create management problems, including algal blooms, the spread of *Elodea*, and lack of food and shelter for fish juveniles and adults.

Raising the awareness of anglers regarding the importance of submerged vegetation for biodiversity should also be encouraged. A draft leaflet aimed at anglers to help them recognise the main different type of submerged plants occurring in the LWV has been produced. Subject to approval with fishery managers, this will be widely distributed to anglers and posted on notice boards (Appendix 2.3).

3.5 Potential for habitat creation for Lesser Bearded Stonewort

Lesser Bearded Stonewort requires good water quality and bare substrate with no tree-shade. This aside, the species is relatively unfussy about its habitat, which includes lakes, ponds, and even calcareous peaty scrapes. This means that there is considerable potential for habitat creation for Lesser Bearded Stonewort near existing sites, and at other sites in the Lower Windrush Valley.

Both gravel pit lakes and new ponds provide potential habitats for Lesser Bearded Stonewort. A pond creation programme, with a few ponds created every few years at suitable sites could be used to maintain the existence of pioneer conditions favoured by Lesser Bearded Stonewort and many other stonewort species. The design of new gravel pit lakes in the valley could also be improved by including stonewort-friendly features such as underwater bars and shoals (see factsheet: '*Creating gravel pit ponds and lakes for stoneworts*' on www.pondconservation.org.uk). Translocation of stoneworts can easily and cheaply be attempted by adding mud from site where species are known to occur, although care should be taken not to introduce species such as Australian Swamp Stonecrop to new sites.

In practice, at both Darlow Water and Unity Lake, there is scope for pond creation schemes (see Appendix 2.1 and 2.2) and the managers of both lakes are willing to explore the feasibility of creating ponds on their site, subject to landowner permission (Oxford Colleges in both cases).

4. Conclusions

This project has shown that Lesser Bearded Stonewort is still present at Darlow Water but at relatively low abundance and with a patchy distribution. The species was not recorded from Unity Lake this year. However, it is currently unclear whether the species has disappeared or if this is due to natural variation. The White-clawed Crayfish population at Downs Road Trout Lake seem, based on the information available, to be small but relatively secure.

Managers and members of all three sites were very supportive of the project and expressed and interest in further work at their sites, including further monitoring to better understand (i) population density and distribution, (ii) the impact of management practices, and (iii) the potential for habitat enhancement and creation. This is important for the long-term survival of both species in the Lower Windrush Valley.

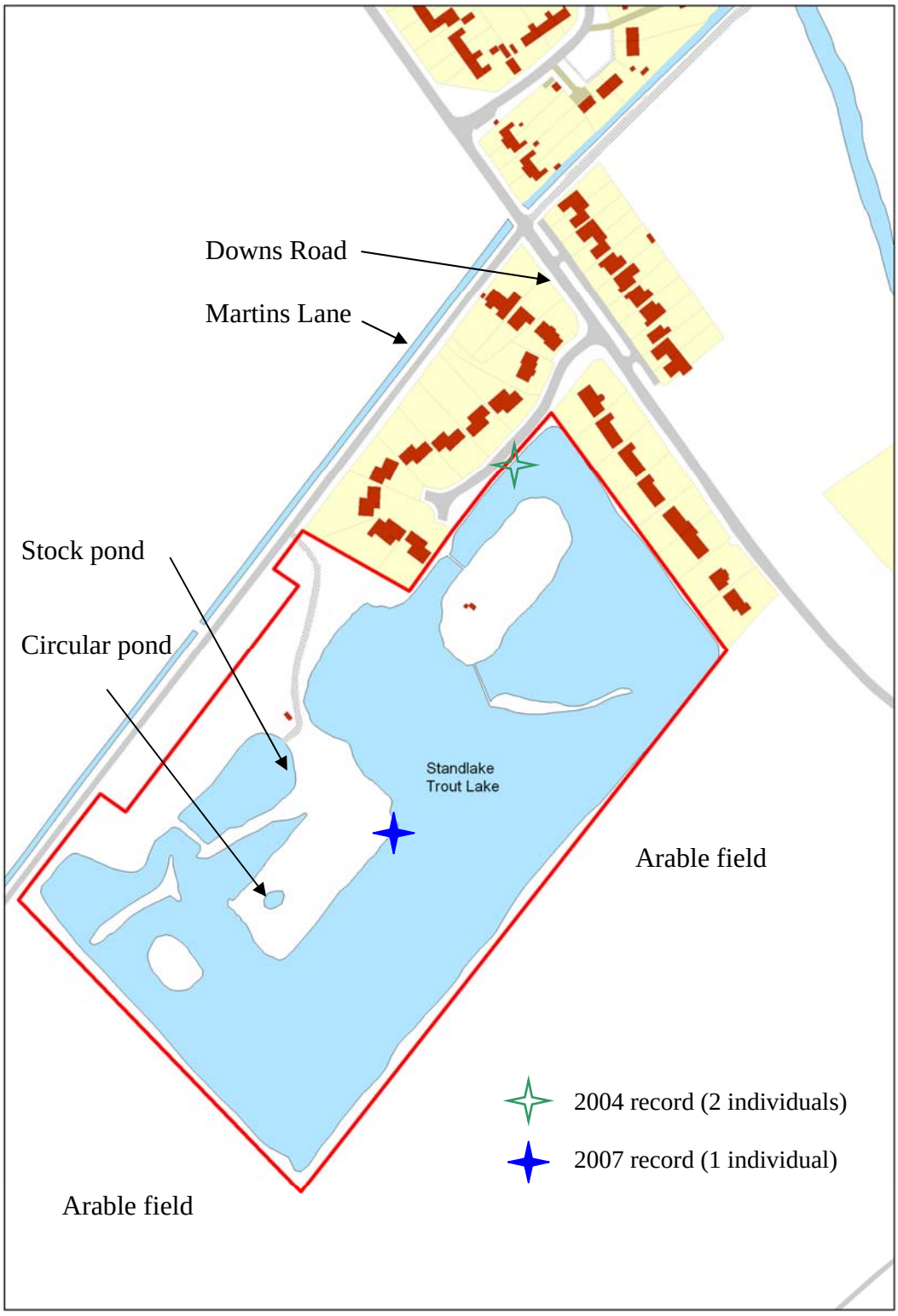
5. References

Nicolet P., Williams P. and A. Hopewell (2008) *Pond on aggregate sites: creating opportunities, reducing barriers*. Pond Conservation, Oxford.

Pond Conservation (2005) *Baseline ecological assessment of 40 gravel pit lakes in the Lower Windrush Valley (Oxfordshire)*. Pond Conservation, Oxford.

Berry F. (2007) *Guidance on the selection of conservation action for white-clawed crayfish (Austropotamobius pallipes)*. Unpublished advice sheet.

Appendix 1.1 Map of Downs Road Trout Lake (No 33, SP393036)



Appendix 1.2 Newsletter article for the Abingdon and Oxford Anglers Alliance

Standlake Trout Lake: the last refuge for the White-clawed Crayfish in the Lower Windrush Valley

In the Lower Windrush Valley, the white-clawed crayfish, our only native species of crayfish, has almost completely disappeared. In fact, it only remains in very few places in the whole of the Thames catchment. It was, therefore, a big surprise when white-clawed crayfish were found in Standlake Trout Lake in 2004, during a survey of aquatic wildlife carried out by Pond Conservation for the Lower Windrush Valley Project. Standlake Trout Lake is almost certainly the only waterbody where our native crayfish still survive in the whole of the Lower Windrush Valley, which makes this lake a rather special place.

White-clawed crayfish have declined dramatically ever since the American signal crayfish was brought over to the UK in the 1970s. They were introduced into the country because they are bigger and meatier than white-clawed crayfish and therefore more attractive to sell to restaurants. This probably seemed to be a great idea at the time but the consequences have been disastrous for our native crayfish.

So why have the signal crayfish almost completely replaced the white-clawed crayfish in our rivers and lakes? There are many reasons. The signal crayfish is a lot tougher and better at competing for food and shelter. Unfortunately, they are also very good at escaping from crayfish farms and can travel over land up to 100m, so once it was introduced to the UK it spread rapidly to all kinds of waterbodies. On top of all this, it brought with it the crayfish plague, a disease deadly only for the white-clawed crayfish. The crayfish plague is easily spread between waterbodies on wet gear, shoes or clothes. All in all, the white-clawed crayfish doesn't stand a chance.

We know, from talking with Malcolm Jones, that white-clawed crayfish were introduced into the lake in the 1960s from the Windrush. Even with the extreme flooding this past summer, the lake doesn't connect with the Windrush and may be the reason why they have survived there. The white-clawed crayfish at Standlake Trout Lake are very important because they may provide a source for reintroduction into rivers and lakes in the area, if we ever find a way to rid ourselves of the signal crayfish. In the meantime, we are looking at creating and managing isolated lakes and ponds where white-clawed crayfish might survive, away from waters infested by the signal crayfish.

Standlake Trout Lake was surveyed again this year to assess the size of the white-clawed crayfish population. Over 40 traps were laid around the margin of the lake and checked twice daily for a week. Unfortunately, only one individual was found (see picture). This means the population in the lake may be very small, and this is worrying. There is a lot of pressure on crayfish, as they are basically food for all the

other wildlife associated with the lake. The very small ones have no defences and are eaten by other invertebrates, like dragonfly larvae. The big ones have claws, but are easily eaten by trout, herons and mink or otters.

The only thing we can do to help the white-clawed crayfish at Standlake Trout Lake is to provide more refuges from those predators. This can be easily and cheaply done this winter by putting inert material, like bricks, in areas which are not fished, for the crayfish to hide in. Another summer survey in the next few years will show if there are more crayfish in the lake.

Fortunately, we have found no evidence of signal crayfish at Standlake Trout Lake or any sign of the crayfish plague, but club members should report any suspicious signs to Alison Hopewell of the Lower Windrush Valley Project (contact details below). We hope anglers will also take extra care to let their gear dry completely or to disinfect it after fishing at other sites, to reduce the chances of transferring the crayfish plague.

Standlake Trout Lake is rich in all kinds of both aquatic and terrestrial wildlife, and is a beautiful and peaceful place quite unlike other lakes in the Lower Windrush Valley. I have really enjoyed doing surveys there, even though I would have preferred to find more white-clawed crayfish!

Pascale Nicolet,
Senior Freshwater Ecologist
Pond Conservation: The Water Habitats Trust

December 2007

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For more information about crayfish, contact the Environment Agency: tel: 08708 506 506, website: http://www.environment-agency.gov.uk/

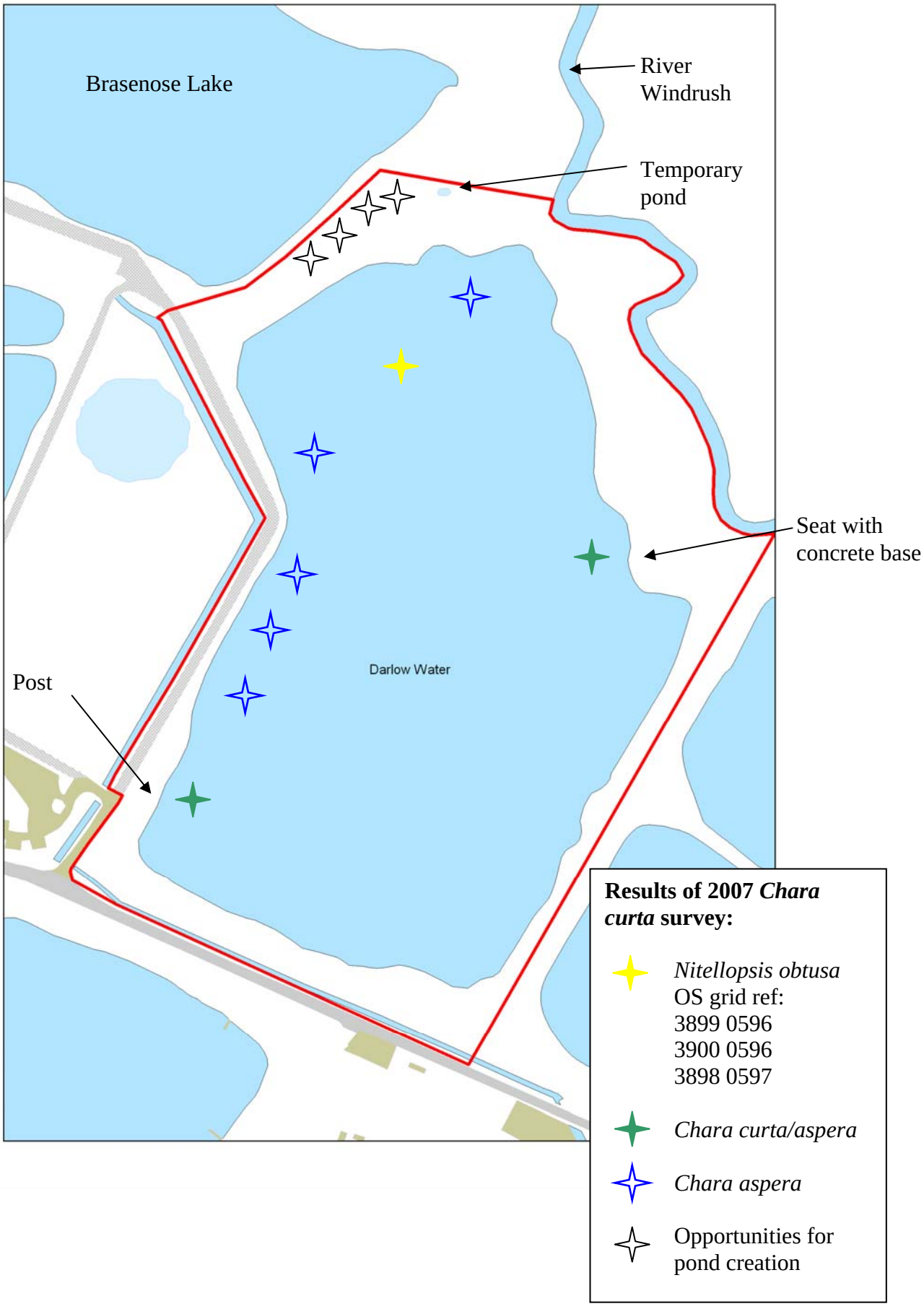
The survey work undertaken at Standlake Trout Lake was funded by Defra's Aggregate Levy Sustainability Fund, which is managed by Natural England.

LOWER WINDRUSH VALLEY PROJECT

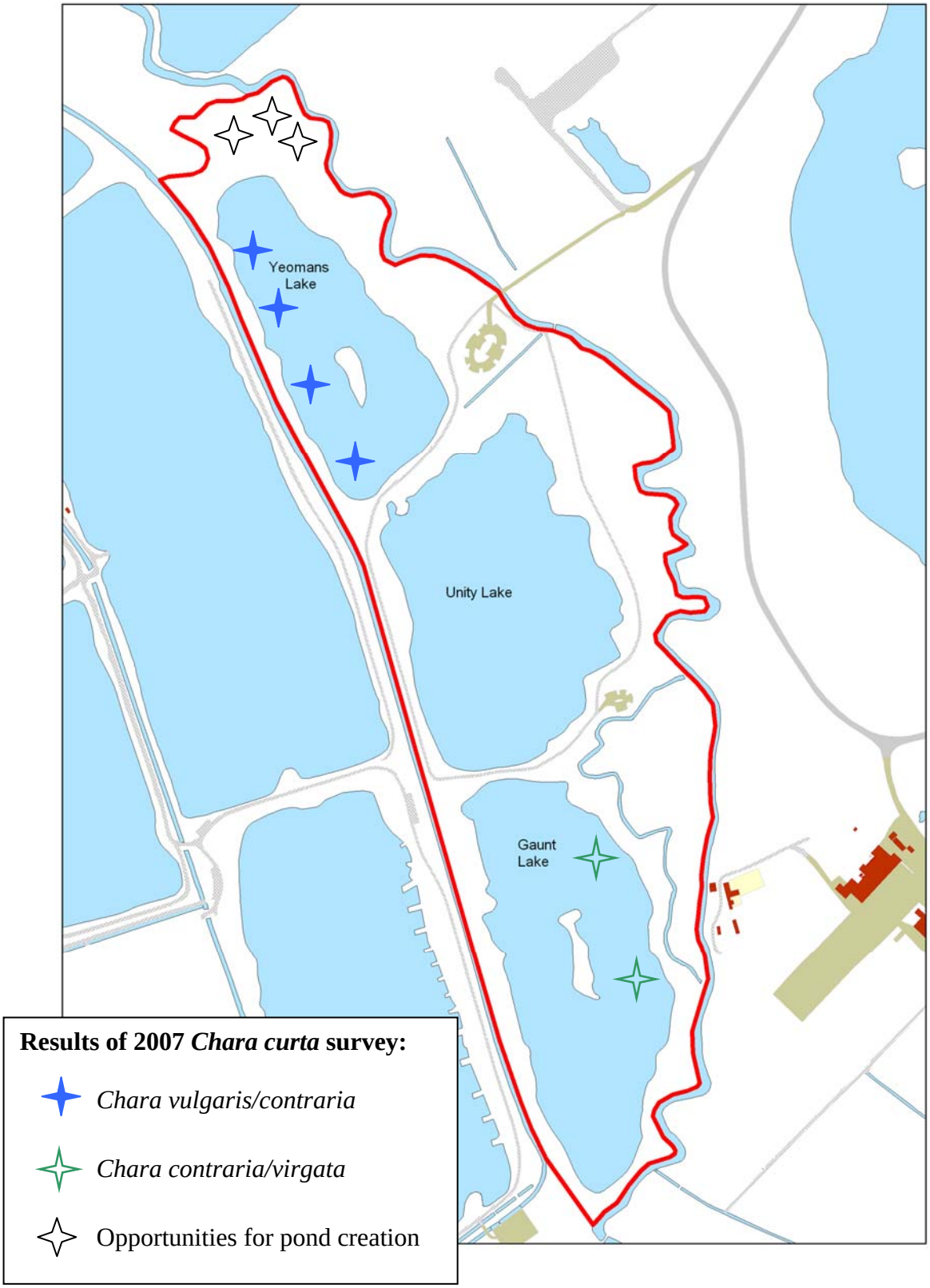
Pond Conservation
For Life in Fresh Waters

NATURAL ENGLAND
Supported through Defra's Aggregates Levy Sustainability Fund

Appendix 2.1 Map of Darlow Water (No 5, SP390058)



Appendix 2.2 Map of Unity Lake (No 14, SP402045)



Appendix 2.3 Draft leaflet on submerged aquatic plants and Australian Swamp Stonecrop