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ENGLISH NATURE SPECIES RECOVERY PROGRAMME

The Glutinous Snail (*Myxas glutinosa* Müller)

A report to English Nature

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SUMMARY

This report presents the results of the first year's work on the Species Recovery Programme for the Glutinous Snail (*Myxas glutinosa*), initiated by English Nature and funded in collaboration with Pond Action.

The Glutinous Snail was once a scarce but widespread species in Britain, often occurring in abundance where it was found. Although it has been recorded from about 36 10x10km squares over the last 150 years, it has all but disappeared in Britain during the second half of 20th century and, at the beginning of 1993, was known from only one site, Kennington Pit, near Oxford.

This first stage of the Recovery Programme has mainly been concerned with assessing the status of the Glutinous Snail in Kennington Pit and the surrounding area. The aims of the work were:

- (i) to determine whether the Glutinous Snail was still present in Kennington Pit and, if possible, obtain more information about the population size and preferred microhabitats of the species within the pond.
- (ii) to gather further information about the water quality of Kennington Pit.
- (iii) to determine whether the Glutinous Snail was present in any other streams, ditches or ponds in the vicinity of Kennington.

Surveys were undertaken at Kennington Pit between May and December 1993, using both hand/net and sub-aqua techniques. **The Glutinous Snail was not recorded at Kennington Pit during any of these surveys.** Monitoring of water quality suggest that Kennington Pit does **not** currently have unusually good water quality for a pond of its type.

Surveys of eight other waterbodies (ponds, ditches and streams) in the Kennington area, using hand/net methods, were made. **One live Glutinous Snail was recorded from the ditch next to Kennington Pit (SP519033).** The site where the snail was found was approximately 1.5m deep, with imperceptible flow. The bed of the ditch was largely made up of gravel and shells, mixed with organic silt and mud. It supported extensive stands of *Callitriche* and *Elodea*. The snail was recorded, apparently feeding, amongst a raft of filamentous algae. Further searches later on the same day (24/5/93), and in November, failed to locate any additional specimens. Water quality in the ditch as a whole appeared somewhat variable, seeming to be turbid and possibly polluted upstream near the Oxford ring road, but improving in quality and clarity further south.

The survey results suggest that the Glutinous Snail population(s) in Kennington Pit and the surrounding area are very small. The single snail recorded could either be part of a previously undiscovered population or simply an animal washed out of Kennington Pit during floods (which were common in winter/spring 1992/93).

Current threats to the existence of the Glutinous Snail at Kennington Pit may include deterioration of water quality, and lack of suitable hard surfaces. Where possible attempts should be made to maintain or improve the quality of the ditch draining into Kennington Pit, since it affects water quality both in the ditch itself and Kennington Pit. It is suggested that the provision of some areas of hard surface, e.g. in the form of weathered concrete blocks, might also prove beneficial

Three areas of further work are suggested for 1994:

- (i) Continued monitoring of the Kennington area.
- (ii) A systematic review of sites in Britain where there are old records to determine whether the Glutinous Snail still occurs in any of these.
- (iii) A review of literature relating to continental European and Irish population to obtain more information about the habitat and ecology of the Glutinous Snail.

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The Glutinous Snail (*Myxas glutinosa* Müller)

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1. INTRODUCTION

1.1 Aims of the first year's work on the Glutinous Snail (*Myxas glutinosa*) for the Species Recovery Programme

This report presents the results of the first year's work on the Species Recovery Programme for the Glutinous Snail, (*Myxas glutinosa*) initiated by English Nature and funded in collaboration with Pond Action.

The aims of the work were:

- i) To determine whether the Glutinous Snail was still present in Kennington Pit (at the beginning of 1993 the only known site for the species in Britain) and, if possible, obtain more information about the population size and preferred microhabitats of the species within the pond.
- ii) To gather further information about the water quality of Kennington Pit.
- iii) To determine whether Glutinous Snails are present in any other streams, ditches or ponds in the vicinity of Kennington Pit.

1.2 Background to the Species Recovery Programme for the Glutinous Snail (*Myxas glutinosa*)

1.2.1 The distribution of the Glutinous Snail in Britain

The Glutinous Snail (*Myxas glutinosa*) was once a scarce but widespread species in Britain. Up to 1950, it had been recorded in 36 10 x 10km squares in Britain, although most records are pre-1914 (Kerney, 1976; Kerney, 1991). By the beginning of 1993 it was known from only one British site (SP518033).

In the past, Glutinous Snails were often abundant where they were found. For example, at Tetney, Lincolnshire, Kew (1903) found a 'considerable assemblage' of the snails which were 'far more plentiful than *Limnaea pereger* L., *L. stagnalis* etc.'. Fierke (1890) called it 'highly prolific', and in Llyn Tegid (Lake Bala) it was once 'common....and found at many different points' (McMillan and Millott 1954).

However, even in 1934, Boycott (1934) regarded the Glutinous Snail as one of the rarest British species, and after 1950 there were records from only four sites. At two of these, Llyn Tegid and Lake Windermere, searches during the 1980s failed to relocate the species (Hope Jones and Yeo, 1989; M. Kerney, pers. comm.). The third site, on the Basingstoke Canal, is represented by a single shell collected in 1969 by Derek Whiteley, which only recently came to light (Walker et al., 1991).

The fourth site is Kennington Pit, where the Glutinous Snail was discovered in 1988. This site, on the edge of Oxford, is within 1.5km of a location at which the species was recorded in 1857 (Crowley and Campbell, 1984¹). Up to the beginning of 1993 Kennington Pit was the only location in Britain where the species has been recorded for some years.

1.2.2 Habitat of the Glutinous Snail

Literature on the Glutinous Snail suggests that it is unspecialised in many of its habitat requirements. It has been found not only in ponds, but also in ditches, rivers, canals, gravel pit pools (Brindley, 1932) and lakes. In Europe, the species is also said to occur in temporary ponds (Illies, 1978) although this seems an unlikely habitat. It has been recorded from a wide variety of substrates (see Table 1), including a number of different species of water plants, stones and bare mud. Although Kerney (1991) states that it has a preference for hard substrates, it certainly occurred in the past in places where rock

¹ Crowley and Campbell (1984) also attribute a record of *Myxas glutinosa* at Godstow in Oxford to Grensted (1926). In fact Grensted only wrote that *Myxas* was 'alleged to have occurred at Godstow'. He does not note who recorded the species, or whether any specimens were preserved.

and stone would have been scarce habitats, with plants most likely to provide firm substrate. Many authors have assumed that, like most other lymnaeids, the species requires waters with high calcium concentrations; however, it was long known from Llyn Tegid and Lake Windermere, which are both low in calcium.

1.2.3 Life history of the Glutinous Snail

Information about the life history of the Glutinous Snail is scarce, but the broad outline can be pieced together from the existing literature and from observations already made at Kennington Pit. Cooper (1931a) found eggs towards the end of May in Kent. He did not describe the substrate on which they were found but, since the habitat was coastal ditches, it seems likely to have been vegetation. Young shells appeared by mid-June when the adults were 'dying off fast'. Young snails were half-grown by the end of July, and at the end of September some appeared mature. Glutinous Snails have been seen in December (Welch, 1900) and 'during the winter months' (Fierke, 1890). This pattern is broadly consistent with observations at Kennington. In November 1988 one immature and one adult specimen were recorded. In August 1990 one adult and four immatures were seen, and in March 1991 one adult was seen. Other general dates of recording (see Table 1) are quite consistent with this interpretation: the animals breed in the spring and early summer, grow through the summer and autumn and overwinter as adults.

Generally, Glutinous Snails are either recorded in ones and twos, or in great abundance, and this has led some authors to postulate that the species has a burst of activity in one area before 'moving on' to another suitable habitat nearby. For example, Jeffreys (1862) notes that the species was recorded in a pond *near* Windermere whereas subsequent records are for Lake Windermere. In Kent, Cooper (1931b) noted that the snail had apparently died out at its original British locality (Deal) but was then found within 12 miles at Chislet Marshes.

Of particular note are reports that several conchologists have successfully kept Glutinous Snails in captivity (Fierke, 1890; Boycott, 1934). None of the reports suggest that keeping the snails is very difficult. Fierke (1890) noticed that the animals fed on, and lived amongst, Ivy-leaved Duckweed (*Lemna trisulca*) in captivity.

1.2.4 Reasons for the decline of the Glutinous Snail

The reasons for the decline of the Glutinous Snail are unknown. It has been suggested that the snails are unusually sensitive to physical and chemical disturbance, particularly eutrophication (Kerney, 1991) but there is still little evidence to support or contradict this view. In Llyn Tegid it seems likely that the loss of the Glutinous Snail population was caused by a period of extreme water level fluctuations, beginning in 1955, caused by the damming of the lake to control the flow of the River Dee. The Glutinous Snail was fairly common in the lake in 1950-52, but has not been seen since (Hynes and Yadav, 1985; Hope Jones and Yeo, 1989).

Further information about the original discovery of the species at Kennington, with additional background information about the Kennington site, is given in a previous report to Joint Nature Conservation Committee (Pond Action 1992).

TABLE 1. EXAMPLES OF THE OCCURRENCE AND HABITATS OF THE GLUTINOUS SNAIL (*MYXAS GLUTINOSA*) REPORTED FROM LITERATURE SOURCES

Author	Location	Dates seen	Number of animals	Habitat
Ashford (1879)	Newry Canal, Co. Down	Sept 1871	2	On Bogbean <i>Menyanthes trifoliata</i> (not on <i>Nuphar lutea</i> which was searched)
	Brusna, King's Co.	Oct 1871	'Pretty plentiful'	On <i>Nuphar lutea</i>
Fierke (1890)	Skidby Drain, near Hull	Sept 1889 and during winter months	In great numbers	On bottom mud and on bladderwort (<i>Utricularia</i> sp) and starwort (<i>Callitriche</i> sp.).
Welch (1900)	Bann River, Co. Armagh	Dec 1899	3	Dead duckweed (<i>Lemna</i> sp.) and plant debris
Green (1901)	Bann River, Co. Armagh	Easter 1901	Plentiful (20)	Mouth of a drain opening into the river.
Kew (1903)	Tetney, Lincolnshire	April 1902	'Considerable assemblage'	On mud
		July 1902	2-3 young shells and dead shells	Not specified
Cooper (1931)	Chislet Marshes, E. Kent	May-Sept 1931	Not specified	Avoids Ivy-leaved Duckweed; on weeds at bottom of ditches [with] plenty of light
Blackburn (1931)	Ditches at Minster Monkton, E. Kent	Aug 1914-15	Fairly abundant	Not specified
Dunn, (1961)	Llyn Tegid	1950-1952	Less than 25/m ² occasional in samples	Littoral (0-3m)
McMillan & Millott (1954)	Llyn Tegid	1852 onwards	Common	Under stones
Pond Action (1992)	Kennington, Oxon	1988	Up to 5	Probably associated with aquatic plants

1.3 Previous surveys at Kennington Pit

During previous surveys by Pond Action at Kennington Pit, Glutinous Snails have been recorded on three occasions:

Date	Specimens found
November 1988	2 specimens: 1 mature and 1 immature
July 1989	None
August 1990	5 specimens: 1 mature and 4 immature
March 1991	1 mature specimen found in an area of organic mud and vegetation, dominated by Long-stalked Pondweed (<i>Potamogeton praelongus</i>) rooted at a depth of about 2.5m
November 1992	None

The surveys undertaken in 1988 and 1990 were macroinvertebrate surveys for the Oxfordshire Pond Survey, and thus provided no specific information about the habitats of the snails in the pond. This was because all material collected on site was pooled to form a single sample for laboratory sorting: material from different microhabitats was not kept separate. In March 1991, however, a specific search was made for the Glutinous Snail. The single specimen recorded during this search appeared to be associated with a stand of Long-stalked Pondweed (*Potamogeton praelongus*) growing in deep water.

2. METHODS USED IN SURVEYS FOR THE GLUTINOUS SNAIL

2.1 Introduction

Surveys for the Glutinous Snail were carried out at Kennington Pit and eight other sites in the vicinity of Kennington and the Hinksey Stream (listed in Appendix 1; see Maps 1-5). Two survey methods were employed: (i) searching by hand and net, and (ii) sub-aqua surveys.

2.2 Hand and net searches

Hand and net searches were used at all sites. Three main techniques were used:

- i) Examination by hand of possible habitat/feeding areas, e.g. stems and leaves of aquatic plants, filamentous algae masses and floating wood.
- ii) Gentle sweeping with a pond-net in all potential habitats, from shallow to moderately deep water (approximately 1.5m deep).
- iii) Examination of (a) sediment and gravel, (b) pond edges, and (c) caddis cases, in order to locate dead shells.

Hand and net searches were carried out at Kennington Pit on 24 May and 29 November 1993. Other sites were surveyed on various dates between 24 May and 29 November 1993 (see Appendix 1).

2.3 Sub-aqua searches

Dives were made at Kennington Pit on 30 June, 20 August, 5 October, 18 November and 7 December 1993. On each occasion, a general search of the pond edges was made, together with searches along transect lines. Particular attention was paid to the area in which a specimen was found in March 1991, and since this individual appeared to be associated with Long-stalked Pondweed (*Potamogeton praelongus*), a special effort was made to locate any stands of this plant. Comments on conditions during dives are given in Appendix 2.

In order to avoid disturbing the loose sediments of the bottom of the Pit, searches were made with the surveyor suspended so that his head was lowermost in the water. This was achieved by differential inflation of the dry-suit. Despite these precautions, some small amount of disturbance was inevitable. Potential specimens were captured using a small aquarium net and were, where necessary, brought to the surface for more detailed examination.

3. RESULTS OF SURVEYS FOR THE GLUTINOUS SNAIL

3.1 Summary

No Glutinous Snails were recorded in Kennington Pit, either by hand/net searches or by sub-aqua diving.

One immature Glutinous Snail was recorded in the ditch adjoining Kennington Pit (SP519033) on 24 May 1993. No individuals were recorded from any of the other seven sites surveyed in the Kennington area.

3.2 Surveys of Kennington Pit in 1993

3.2.1 Conditions in Kennington Pit in 1993

During 1993 Kennington Pit supported a variety of aquatic plants and little hard substrate. The bottom of the deeper areas of the pond was covered in loose silt and appeared unsuitable for snails. Indeed no species of snail were observed in this area at all during the sub-aqua surveys. It is, of course, not known whether bottom areas of firm sediment were available in previous years. Areas of gravel and expanses of exposed clay seem to be attractive to snails, but in Kennington these now appear to be relatively few and largely restricted to exposed banks at shallow depths (ca. 0.15m below low water in 1993) and a small number of old wooden fishing platforms.

Most snail species recorded during the dives appeared to be associated with wetland or aquatic plants. Nuttall's Waterweed (*Elodea nuttallii*), Rigid Hornwort (*Ceratophyllum demersum*) and Unbranched Bur-reed (*Sparganium emersum*) were all present, except in the deepest areas. However, Long-stalked Pondweed (*Potamogeton praelongus*), with which the Glutinous Snail seemed to be associated in 1991, was not seen in 1993.

3.2.2 Effectiveness of the sub-aqua survey methods

Sub-aqua searches seemed to be reasonably effective for recording aquatic snails in Kennington Pit. During the five sub-aqua dives a total of 15 snail species were found. This compares with a total of 21 species recorded during three previous hand-net searches of Kennington Pit (see Appendix 3 and Pond Action 1992). Of the species which were missed, most were small (e.g. *Hippeutis complanatus* and *Potamopyrgus jenkinsi*) or relatively uncommon in the pond. However, it remains possible that small numbers of Glutinous Snails could be missed using the sub-aqua method, especially if they were living in areas which could not easily be searched by diving.

3.2.3 Conclusion from surveys at Kennington Pit

The fact that both sub-aqua and hand-net techniques failed to locate Glutinous Snails suggests that the species is currently either extremely uncommon in, or absent from, Kennington Pit.

3.3 Searches for the Glutinous Snail at other sites in the Kennington area

Additional searches for the Glutinous Snail were made at eight waterbodies in the vicinity of Kennington, using hand and net techniques (see Section 2). Sites included streams, ditches and ponds. One of these sites, the Hinksey Stream, is known to have supported the Glutinous Snail in the 19th century (see Pond Action 1992). Brief descriptions of the survey sites are given in Appendix 4 and locations are shown on Maps 1-5.

A single immature Glutinous Snail was recorded from the ditch running parallel to Kennington Pit (SP519033) on 24 May 1993. This ditch is intermittently connected to Kennington Pit via a small semi-permanent inflow and during periods of overbank flooding. The snail was found at the end of a mud spit in deep water, just south of Kennington Pit. The ditch at this point was about 1.5m in depth and 8-9m in width. It supported extensive stands of *Callitriche* and *Elodea* spp.. The bed was largely composed of gravel and shells, mixed with organic silt and mud. The water quality appeared somewhat variable, seeming to be turbid and possibly polluted upstream, near the Oxford bypass, but improving in clarity further south (adjacent to private gardens in Kennington). The single Glutinous Snail recorded

COMMUNICATIONS

TWO NEW BRITISH RECORDS FOR *MYXAS GLUTINOSA* (MÜLLER)

The lymnaeid *Myxas glutinosa* (the glutinous snail) is one of only two species of snail (and 20 species of invertebrate) which is protected in Britain under Schedule 5 of the Wildlife and Countryside Act. The last record for *M. glutinosa* in Britain is from Lake Windermere in 1957 and the last record for lowland Britain from around Norwich in 1940 (M. P. Kerney pers. comm.). In contrast to its present rarity, the species used to be relatively widespread in England and Wales. The decline of the species is thought to be associated with the general decrease in the quality of surface water in Britain over the past century.

M. glutinosa has now been rediscovered during the course of the National Pond Survey, co-ordinated by Pond Action from Oxford Polytechnic, at a site in the Oxford area (SP50). Two living specimens, one mature and one juvenile, were recorded in November 1988, and several living juveniles recorded in July 1990. The new site is quite close to the sites of some old records for the species, the most recent of which is from 1916.

The site at which the species has been found is an old, flooded, gravel pit which has a seasonal connection to a network of surrounding watercourses. The site has a rich snail fauna, 19 aquatic species being recorded from two visits. The site also has an excellent flora including the local species *Potamogeton praelongus* (long-stalked pondweed), also thought to be declining rapidly due to a decrease in surface water quality (T. G. C. Rich pers. comm.).

The known habitat preference for *M. glutinosa* is for firm surfaces and crystal clear water (M. P. Kerney pers. comm.). Unfortunately, the present condition of the site, with a silted base and much green algae, appears to be far from ideal for this species. In addition, it appears that the condition of the site has been deteriorating over the past few years. It is evident that very careful management will be needed in order to ensure the continued survival of *M. glutinosa* at this site.

This record stimulated Mr. D. Whitely, to extract from his collection a specimen of *M. glutinosa* collected from the Basingstoke canal (SU85) in 1969. This specimen was taken from the bed of the canal when a section had been drained down. The shell was adult and appeared to be fairly fresh.

The canal, which is the richest site for aquatic plants in the U.K., has been undergoing a continuous restoration programme since the early 1970s, and will be fully opened to navigation in 1991. English Nature is concerned about the pressures that the opening will have on the flora and fauna of the canal (P. Tinning pers. comm.). If *M. glutinosa* is still present in the canal, it may well be one of the first species to suffer.

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MAIZANIA MARSABITENSIS VERDC. (MAIZANIIDAE) IN TANZANIA

A single specimen of *Maizania marsabitensis* Verdc. (*Arch. Molluskenk.*, 92 (1963) pp. 15–17) was found in the East African collection made by Å. Holm loaned to me by the Natural History Museum in Stockholm. This had been collected in Tanzania on the rim of Ngorongoro Crater at 2250 m on 19th March 1969, *Holm* 223/224; it occurred with *Afroconulus iredalei* (Prest.), *Guppya rumrutiensis* (Prest.), two indeterminate Helicidae and a juvenile *Gulella*. This represents a considerable extension of range of about 500 km, apart from a new territorial record.

BERNARD VERDCOURT
Spring Cottage, Kimbers Lane, Maidenhead, Berks., SL6 2QP

was apparently feeding, in company with many other species of snail and invertebrate, in a large mass of filamentous algae. The individual was returned to the same area after examination. Further searches later on the same day failed to record further specimens

Additional searches of the ditch in autumn failed to yield any further specimens. It should be noted, however, that the ditch was flooded during this time and therefore not so accessible for hand-searching. (This was particularly true of the area where the Glutinous Snail had been recorded in May.)

Searches for the Glutinous Snail in the remaining seven sites were unsuccessful.

Photographs of the three sites where *Myxas glutinosa* has been found in past and present surveys (Hinksey Stream at Devil's Backbone bridge - SP511044, Kennington Pit - SP51870339 and the ditch next to Kennington Pit - SP519033) are given in Appendix 7.

3.4 Other species of interest recorded during searches for the Glutinous Snail in 1993.

During the searches for the Glutinous Snail in the Kennington area, two other invertebrate species of interest were recorded: the Club-tailed Dragonfly (*Gomphus vulgatissimus*) and the leech *Boreobdella verrucata*. Further details are given in Appendix 5.

4. WATER QUALITY IN KENNINGTON PIT

Water sampling from Kennington Pit started on 25 November 1993 and will continue at monthly intervals for six months; if necessary, the sampling will be extended for a further six months. Although negotiations with the NRA to undertake this work began in May, an NRA internal re-organisation (during which the water chemistry laboratory became an independent contractor) necessitated a considerable delay.

Some water quality data is also available from survey work undertaken by Pond Action in March 1989 (Pond Action 1993a).

4.1 Methods

Duplicate water samples were taken at a depth of 1 metre, 3 metres from the east side of the pond in bay 3 (the area of the March 1992 Glutinous Snail record). Once collected, samples were kept cool and dark before transport to the NRA Thames regional laboratory in Reading.

Kennington data was compared with the results of water quality surveys of 63 Oxfordshire ponds with stream inflows using data from the Oxfordshire Pond Survey (pH, total oxidised nitrogen and chloride) and with the results of monitoring of new ponds dug in gravels beside the river Thames on Pinkhill Meadow, Oxfordshire (biochemical oxygen demand, ammonical nitrogen and phosphate) (Pond Action 1993a; Pond Action, 1993b). The Oxfordshire Pond Survey did not include analyses of biological oxygen demand (BOD), ammonia or phosphate. Note that total oxidised nitrogen (TON) includes both nitrate and nitrite with nitrate making up about 95% of TON.

4.2 Results

The results of the November 1993 survey are given in Appendix 6, together with the data from March 1989.

In March 1989 the concentration of total oxidised nitrogen (TON) was 3.0 mg/l, this being just below the median value for sites with an inflow in Oxfordshire. In November 1993 the TON concentration was 1.1 mg/l. TON concentrations in ponds tend to be at their maximum in early spring, so the lower value for November is to be expected.

The pH in March 1989 of 8.9 was unusually high (in the top 3% of all ponds in the OPS). In November 1993 the pH was 7.9 and, although somewhat lower, this value still lies within the top 25% of ponds with an inflow in the OPS.

The chloride levels in the March 1989 and November 1993 surveys (54 and 41 mg/l respectively) were in the top 10% and 20%, respectively, of the values recorded during the OPS for sites with inflows. Some element of road runoff might explain these results, though the values are not particularly worrying in their own right.

Ammonia and phosphate were not detected in the November 1993 survey of Kennington; similar results have been seen in the ponds at Pinkhill Meadow where these two determinands rarely occur at detectable levels.

5. CONCLUSIONS

The 1993 surveys suggest that the Glutinous Snail populations in Kennington Pit and the surrounding area are currently very small. However, it is not known whether they are (a) naturally small population(s); (b) the tail-end of declining population(s); or (c) a low phase in the population(s) of a species which may 'boom and bust' at irregular intervals.

Finding a single specimen in the ditch close to the original site is particularly difficult to interpret. It could indicate an additional and completely separate population of the Glutinous Snail in this ditch. However, since the ditch is linked during periods of high water-level to Kennington Pit, it may have been an animal which was washed from the pond during overbank flooding (which was common in late 1992/early 1993). On the other hand, as noted with in Section 1.2.3, some authors have suggested that the species may have bursts of activity in one area and then move on to another suitable habitat nearby; the Kennington snails may be following this pattern.

The only two individuals which have been recorded from known habitats in the Kennington area were both taken from amongst plants (*Potamogeton praelongus* in Kennington Pit in 1991, and filamentous algae in the adjacent ditch, where there were also large amounts of *Callitriche* and *Elodea*). This suggests that plants may be an important substrate for the snail. Whether the Glutinous Snail also uses, or needs, hard substrates is still not known. It seems clear from the sub-aqua dives that the absence of hard surfaces on the bottom of the deeper parts of Kennington Pit may make this area generally unsuitable for snail species; however, small areas of gravel are still exposed in some shallow areas and the presence of a small number of wooden fishing platforms may provide additional habitat; certainly many snails were observed in these shallower areas during the hand searches.

Overall, until a larger population is found it will be impossible to do more than guess at the factors currently affecting the size of the Glutinous Snail population present at Kennington.

6. SITE MANAGEMENT

6.1 Current threats to the existence of the Glutinous Snail at Kennington

The most likely threats to the Glutinous Snail at Kennington were identified by Pond Action (1992) as:

- (i) Deterioration of water quality, particularly through eutrophication.
- (ii) Lack of suitable hard, substrates (if the species does, indeed, have a preference for these).

The 1993 survey does not provide evidence of any additional threats.

The few results available from water chemistry surveys suggest that the pond is about average for similar sites in Oxfordshire. Since many of these sites, however, are quite badly polluted, this suggests that Kennington may not currently have exceptionally 'clean' water. Ideally, therefore, there should be an aim to improve the water quality of the pond, not just prevent any further deterioration.

The results of the diving surveys show that there is little in the way of hard surfaces available, particularly in the deeper areas of the pond. Although it remains unclear just how important this is to the Glutinous Snail, it may be worthwhile to make some provision.

6.2 Current site management

Kennington Pit is owned by the Vale of White Horse District Council. The site is occasionally used by a local fishing club, which may have stocked the pond at low intensity in the past.

In 1991 the Council accepted plans, set out by Pond Action, Oxford Urban Wildlife Group and BBONT, (Antrobus et al. 1990) to turn the site into a Local Nature Reserve. Pond Action are now writing a detailed management plan for the site.

6.3 Suggestions for future management

The future management of the Kennington site is currently being addressed in a management plan for the site which is being prepared by Pond Action for the Vale of White Horse District Council. A provisional summary of the plan is given below.

- (i) Recording of an individual Glutinous Snail in the ditch adjacent to Kennington Pit suggests that this area should be included in the new Kennington Pit Local Nature Reserve, if possible.
- (ii) Good water quality may be critical to the survival of the Glutinous Snail in Kennington Pit and the surrounding area. Attempts should be made to maintain or improve the quality of water draining into the Kennington ditch, since it affects water quality both in the ditch itself and Kennington Pit (see Section 5.3 in Pond Action 1992). Water quality in the ditch may be affected by run-off from the Oxford bypass. However, the quality of the ditch water above the bypass also seems to be rather poor, so it is likely that significant improvements will not be achieved without considering a much larger catchment area.
- (iii) Whilst there is no evidence of the need for hard substrates from this survey, the provision of some areas of relatively firm substrate could be beneficial and is unlikely to be positively damaging. This would probably be best provided in the form of concrete or limestone blocks (perhaps concrete fence posts) placed at various depths in the Pit.

7. RECOMMENDATIONS FOR FURTHER WORK

The results of the first years work on the Recovery Programme suggest three main options for further work:

- (i) Continued monitoring of the Kennington area.
- (ii) A systematic review of sites in Britain where there are old records to determine whether the Glutinous Snail still occurs in any of these.
- (iii) A review of literature relating to continental European and Irish population to obtain more information about the habitat and ecology of the Glutinous Snail.

7.1 Continued monitoring of the Kennington area

The continued occurrence of very small numbers of the Glutinous Snail in the Kennington area indicates that continued monitoring of the population is required. In addition, although little new information about the habitat requirements of the species has been obtained during 1993, it is suggested that measures which might improve the habitat of the snail should be taken.

The following work is suggested:

- i) Low-intensity surveying at Kennington Pit and the adjacent ditch in spring and early autumn to monitor the Glutinous snail population(s), with provision for funding more detailed habitat/life history studies if a larger population is found.
- ii) In addition, it may be appropriate to introduce of hard surfaces (probably weathered concrete fence posts and old wooden, preservative free, pallets) with subsequent monitoring of these by sub-aqua diving. We would anticipate a similar number of diving surveys to those undertaken during 1993.

7.2 A systematic review of old sites to determine whether the Glutinous Snail still occurs in any of these.

The persistence of the Glutinous Snail in the Kennington area, undetected for over 50 years and believed to be extinct in the area as long ago as 1926 (Grensted, 1926), suggests that searches of other old sites would be valuable.

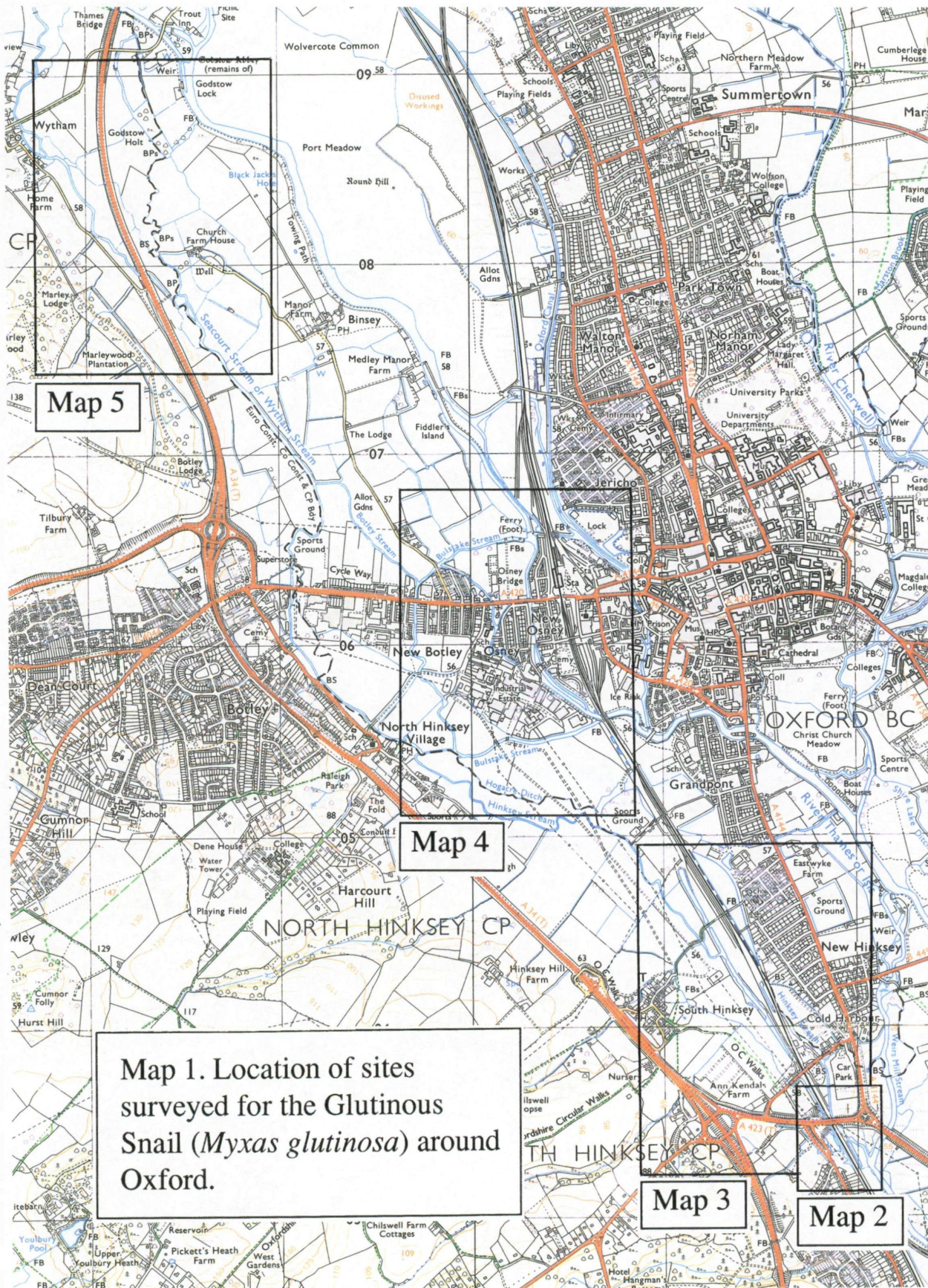
It is suggested that literature on all former sites is reviewed to develop a programme plan for surveying the most promising of these areas (eg sites in which populations were recorded over a number of years in the past).

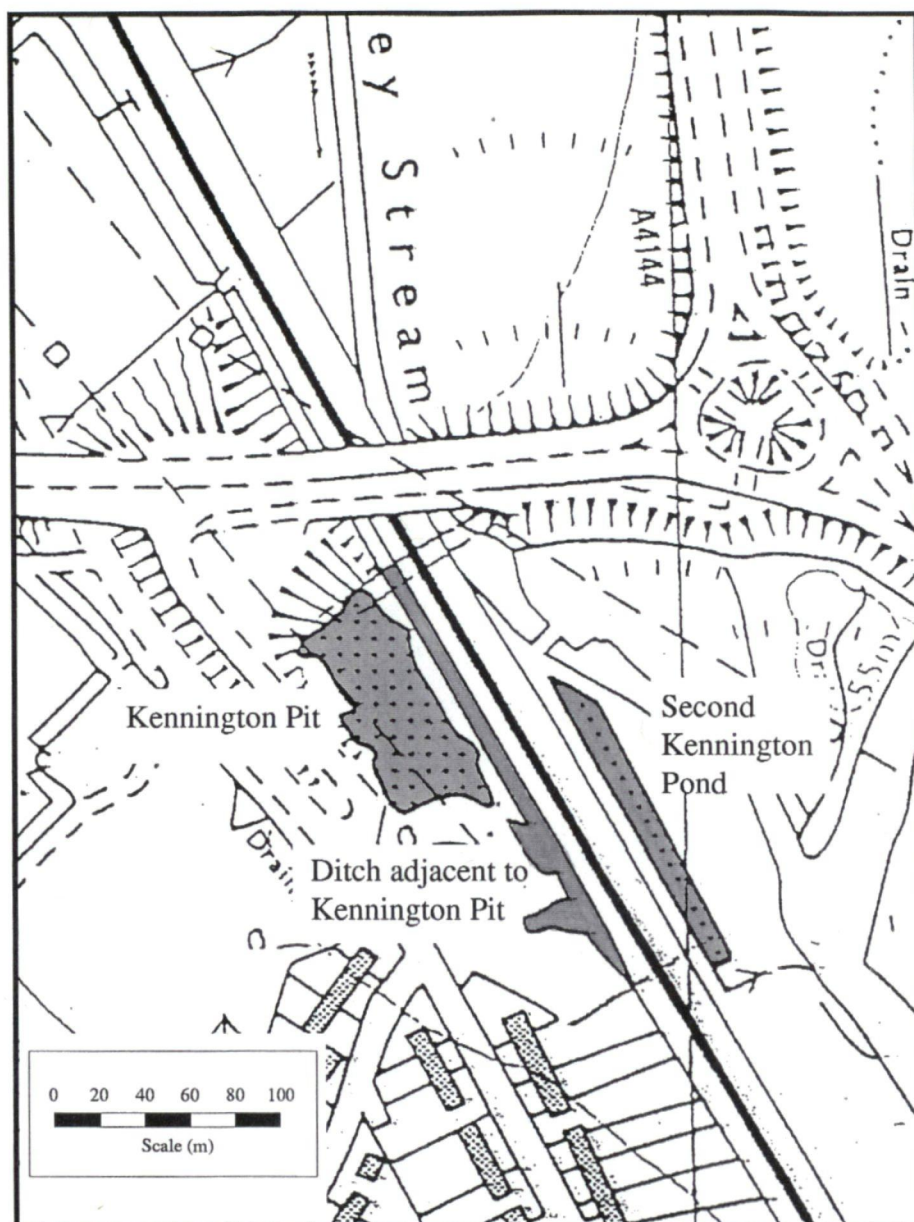
7.3 A review of literature relating to continental European and Irish populations to obtain more information about the habitat and ecology of the Glutinous Snail.

Protection of the Glutinous Snail is made difficult by the lack of information about its ecology. Ideally, studies of a good-sized population are needed to overcome this problem and it might be beneficial to consider studies of non-British populations for this reason. However, as a precursor to any further field studies we recommend that a desk study of extant sites in continental Europe and Ireland is undertaken to obtain further information about the habitat requirements and ecology of the Glutinous Snail in these areas. This would involve literature reviews and consultation with the relevant people and organisations with an interest in the species.

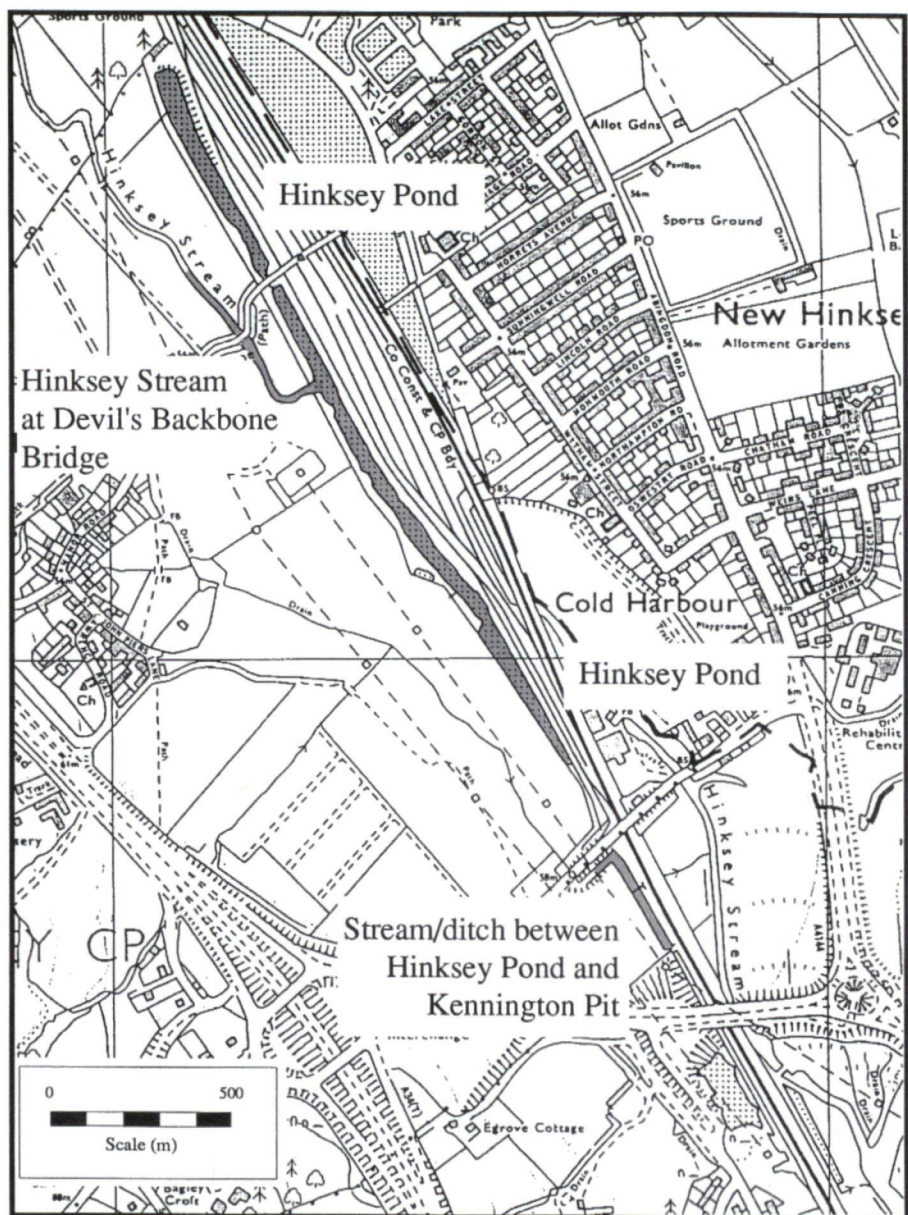
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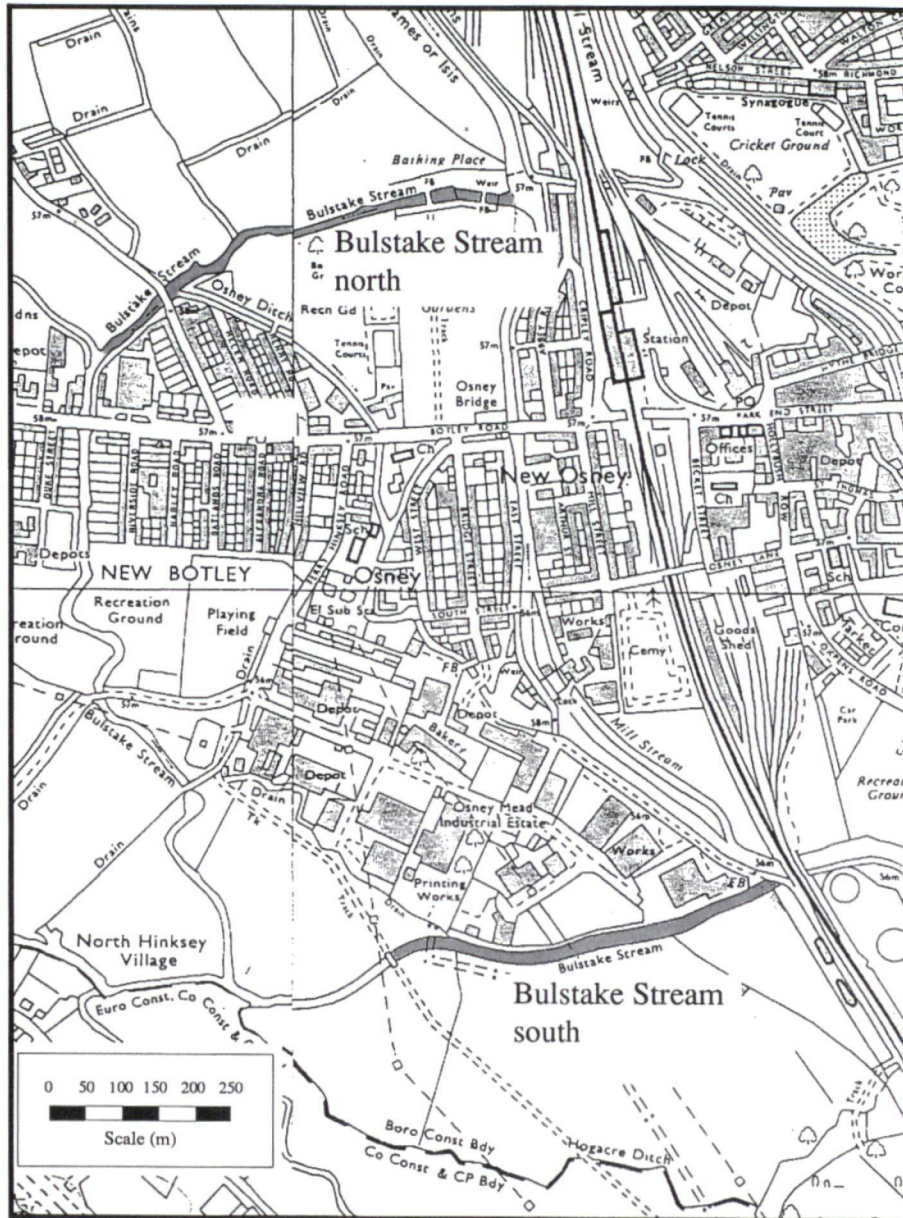




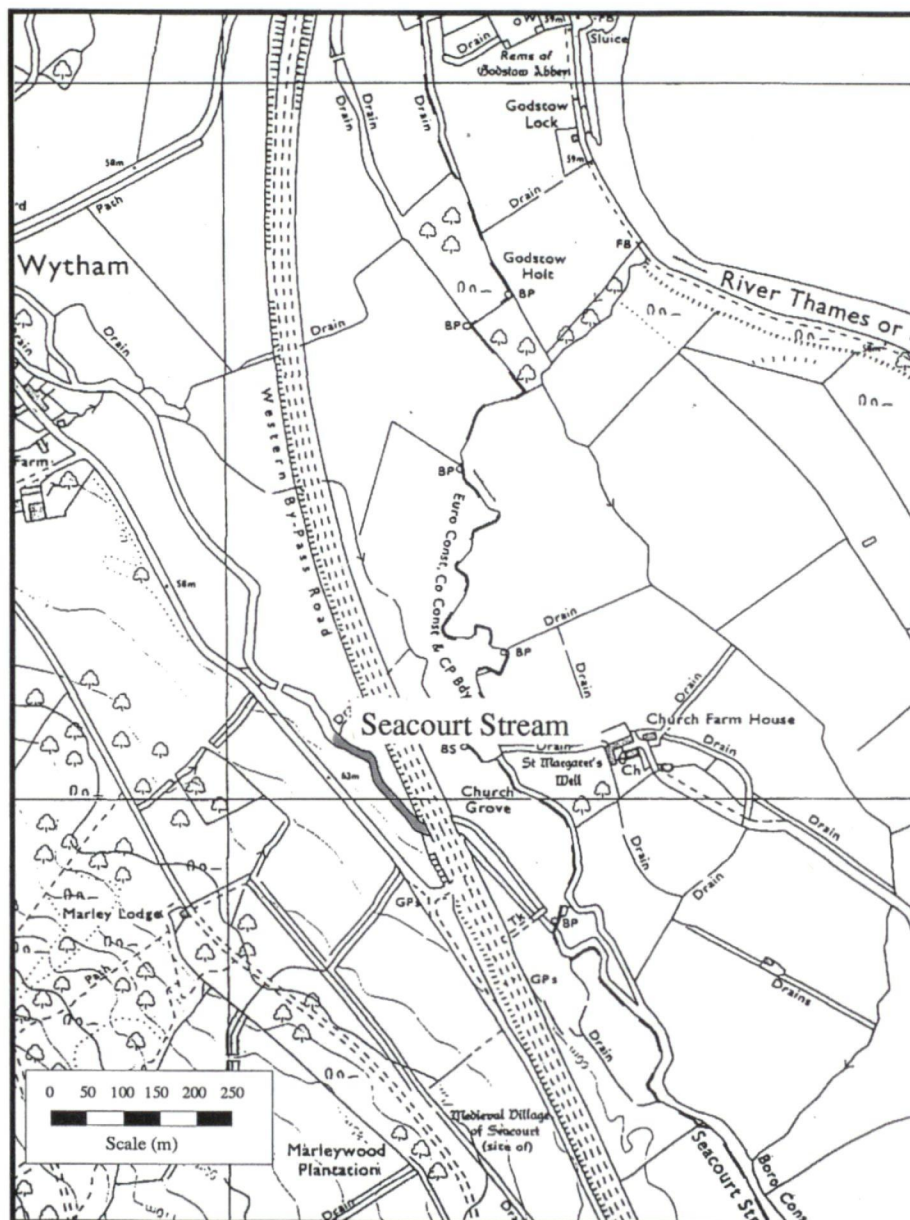
Map 2. Kennington Pit, ditch adjacent to Kennington Pit and Second Kennington Pond.



Map 3. Hinksey Stream at the Devil's Backbone Bridge, Hinksey Pond and stream/ditch between Hinksey Pond and Kennington Pit.



Map 4. Bulstake Stream north and Bulstake Stream south.



Map 5. Seacourt Stream.

APPENDICES

APPENDIX 1. GLUTINOUS SNAIL SITES SEARCHED (BY HAND) IN 1993.

Grid reference	Site	Date of spring survey	<i>Myxas</i>	Date of autumn survey	<i>Myxas</i>
SP520034	Second Kennington pond	24/5/93	-	n/s	-
SP500065	Bulstake Stream (north)	16/5/93	-	n/s	-
SP499055	Bulstake Stream (south)	20/5/93	-	n/s	-
SP481082	Seacourt Stream	23/5/93	-	n/s	-
SP511044	Devil's Backbone bridge	18/5/93	-	29/11/93	-
SP512045	Hinksey Pond	18/5/93	-	29/11/93	-
SP519033	Ditch next to Kennington Pit	24/5/93	+	29/11/93	-
SP517037- SP518035	Stream/ditch between Hinksey Pond and Kennington Pit	n/s	-	29/11/93	-

n/s = not surveyed.

**APPENDIX 2. SUB-AQUA SEARCHES FOR THE GLUTINOUS SNAIL
CARRIED OUT IN KENNINGTON PIT IN 1993**

Date	Duration	Area covered	Visibility	Notes
30/6/93	2 hours	Basins* 1,2,3 & 4	15-50cm	Deep sediments (to 40cm) present in deep water. More promising gravel habitats at edges. Low visibility and disturbance caused some difficulty. Some aquatic plants present (<i>Elodea nuttallii</i> , <i>Nuphar lutea</i> , <i>Ceratophyllum demersum</i> and <i>Sparganium emersum</i>), but all round the edge with none in deeper water. No sign of <i>Potamogeton praelongus</i> . Several species of snail clearly visible on plants and on gravels near edges.
20/8/93	2 hours	Basins 2 & 4.	50-75cm	Much better visibility than previous dive. Plants noticeably more abundant but still only around the edges. Several snail-egg masses present.
5/10/93	2 hours	All basins	to 100cm	Water levels higher than previous occasion. Visibility in basins 5 and 6 very good, but less so (to ~60cm) in other basins. Aquatic plants, particularly <i>E. nuttallii</i> , now growing much further out into water. Higher water levels allow better visualisation of snails on emergent species, with <i>Anisus vortex</i> being particularly evident.
18/11/93	2 hours	Basins 6 to 3	40cm	Despite generally poor visibility, areas slightly overhung had better visibility. <i>Elodea nuttallii</i> dominant and abundant and growing much further into water, though still not present in deeper water. Snails apparently much more abundant and in greater diversity than any other survey.
5/12/93	2 hours	Basins 1,2 & 3	30cm	Visibility as on 18/11 dive. Water levels now at their highest and <i>Elodea nuttallii</i> at its greatest abundance. Still many snails but not as abundant as 18/11 dive. Still a large area of open water in the middle of all bays.

* Basins counted from north, i.e. basin 1 is furthest north, 6 furthest south etc.

APPENDIX 3. AQUATIC INVERTEBRATES RECORDED DURING FIVE SUB-AQUA DIVES AT KENNINGTON PIT BETWEEN JUNE AND DECEMBER 1993

TAXA	FREQUENCY	ABUNDANCE	DEEP	SHALLOW
TRICLADIDA				
<i>Dendrocoelum lacteum</i>	Rare	Low	+	-
HIRUDINEA				
<i>Glossiphonia complanata</i>	Rare	Low	-	+
GASTROPODA				
<i>Acroloxus lacustris</i>	Occasional	Low	-	+
<i>Anisus vortex</i>	Frequent	High	-	+
<i>Armiger crista</i>	Rare	Low	-	+
<i>Bathyomphalus contortus</i>	Occasional	Low	-	+
<i>Bithynia leachi</i>	Occasional	Medium	+	+
<i>Bithynia tentaculata</i>	Occasional	Medium	+	+
<i>Gyraulus albus</i>	Rare	Low	-	+
<i>Lymnaea auricularia</i>	Occasional	Medium	+	-
<i>Lymnaea peregra</i>	Frequent	High	+	+
<i>Lymnaea stagnalis</i>	Rare	Medium	+	+
<i>Physa fontinalis</i>	Occasional	Low	-	+
<i>Planorbarius corneus</i>	Occasional	Low	+	+
<i>Planorbis carinatus</i>	Frequent	Medium	-	+
<i>Viviparus contectus</i>	Frequent	Low	+	-
<i>Viviparus viviparus</i>	Frequent	Low	+	+
BIVALVIA				
<i>Anodonta anatina</i>	Frequent	Low	+	+
<i>Anodonta cygnaea</i>	Frequent	Low	+	-
<i>Sphaerium corneum</i>	Occasional	Low	-	+
MALACOSTRACA				
<i>Asellus aquaticus</i>	Frequent	Low	+	+
EPHEMEROPTERA				
Baetidae	Rare	Low	-	+
HETEROPTERA				
<i>Notonecta</i> sp.	Rare	Low	+	-
TRICHOPTERA				
<i>Limnephilus</i> spp.(flavicollis type)	Frequent	High	+	+
COLEOPTERA				
<i>Dytiscus ?marginalis</i>	Rare	Low	-	+
<i>Haliplus</i> sp.	Rare	Low	-	+
<i>Hyphidrus ovatus</i>	Occasional	Low	-	+

Frequency: How often a taxon was observed.

Abundance: The numbers of that taxon observed.

APPENDIX 4. DESCRIPTIONS OF SITES SURVEYED

Kennington Pit (SP51870339). A small (0.47ha) gravel-pit pond situated within an approximately rectangular area (ca. 1.3 ha) between the Oxford-London railway, the Oxford ringroad, a slipway to the ringroad and an area of rough pasture. The pond is believed to be between 59 and 72 years old, and is relatively deep (2.8m maximum), with a bottom covered in loose silt (0.4m maximum). Vegetated spits of land extend into the pond, dividing it into six connected bays. The Pit is believed to be fed primarily by groundwater and a ditch which runs between the pond and the Hinksey stream. Run-off from the slip-road is believed to be another, minor, source of water. More detailed descriptions of the pond and its hydrology can be found in Pond Action (1992).

Second Kennington pond (SP520034). A long, very shaded, deep stagnant pond, close to Kennington Pit, but on the other side of the railway, and possibly more affected by pollution. Extremely choked with leaf litter. There is an inflow at one end, but on the date of survey this was nearly dry.

Bulstake Stream (north) (SP500065). This is a slow-flowing channel between the Botley Stream (which was included) and the Thames. Part of this stretch has apparently been relatively recently deepened and/or straightened, since the banks had a bare, earthy appearance. The search was therefore extended to cover a cleaner pebble-bottomed stretch near to Tumbling Bay (a public bathing area) and the deeper, wider stretch between Tumbling Bay and the Thames.

Bulstake Stream (south) (SP499055). A slow-flowing channel between the Botley Stream (again, included) and the Thames south of Botley. The stream varies in depth at this point, becoming fairly deep where it widens. The stream bed is mainly pebbles, cobbles and boulders, with some muddy areas.

Hinksey Stream at Devil's Backbone bridge (SP511044). Surveyed on 18/5/93 and 29/11/93. This is the last site (where an exact location was given, in 1857) in Oxfordshire for the Glutinous Snail. Particular attention was paid to the area directly beneath and around the bridge itself. The stream bed is mainly pebbles and cobbles, with silty vegetated areas.

Seacourt Stream (SP481082). A stream with apparently good water quality at this point, and with a faster flow than most other sites chosen. The stream bed, again, is mainly pebbles and cobbles, with some sandy/muddy areas.

Hinksey Pond (SP512045). This pond is connected to the Hinksey Stream; it has a gravel bed, though with some build-up of silt and organic debris in places. The water quality appears to be good. The site comprises two large, deep 'ponds' linked by a narrow, shallow channel with a slight flow which passes underneath the Devil's Backbone footpath.

Ditch next to Kennington Pit (SP519033). The ditch at this point was about 1.5m in depth; it flows past, and into, Kennington Pit. The bed was largely made up of gravel and shells, mixed with organic silt and mud. There were extensive stands of *Callitriche* and *Elodea*. The water quality appeared somewhat variable, seeming to be dirty and polluted near the bypass, but improving in cleanness and clarity further down, where it ultimately backs onto private gardens in Kennington.

Stream/ditch between Hinksey Pond and Kennington Pit (SP517037-SP518035). The flow varied from slow to imperceptible. The water quality did not, in general, appear to be good: there was a distinctly 'drainy' smell in places, and in addition some dumping of rubbish had occurred.

APPENDIX 5. OTHER SPECIES OF INTEREST RECORDED DURING SEARCHES FOR THE GLUTINOUS SNAIL IN 1993.

Gomphus vulgatissimus (ODONATA: Gomphidae). The Club-tailed Dragonfly.

Recorded from Bulstake Stream (north) near Tumbling Bay (SP500065) on 16/5/93.

A local and uncommon species with a rather sparse distribution along the Thames, Wye and Severn rivers and in Sussex. Appears to be well-established where it occurs, but tends to be present only in small numbers. Adults hawk along streams and rivers, often as solitary individuals, whilst larvae burrow in the sand or silt on the bottom. (Hammond, 1983.) The Oxford area is a stronghold for this species.

Boreobdella verrucata (HIRUDINEA: Glossiphoniidae). A leech.

Recorded from: (i) Bulstake Stream (south) (SP499055) on 20/5/93; (ii) Devil's Backbone bridge (SP511044) on 18/5/93; (iii) Ditch next to Kennington Pit (SP519033) on 24/5/93.

A rare leech, with, however, no official status at present because its exact distribution is as yet unknown. Several recent records show that it appears to be fairly well-established in certain locations around the Thames Valley area, and is certainly not as rare as was once thought. Mature specimens of the species bear a superficial similarity in appearance to *Theromyzon tessulatum* in breeding condition, and immature specimens are confusable with *Glossiphonia complanata*; these similarities, coupled with the fact that *Boreobdella* is not included in the 'British Freshwater Leeches' coloured plate in the Elliott and Mann key, may have led to under-recording of this species in the past. Whilst little is known about the ecology of this leech, it is known to feed on the body fluids of molluscs, and to inhabit lakes, slow-flowing streams, and rivers. (Elliott and Mann, 1979; Elliott and Tullett, 1982; Pond Action, unpublished data.)

APPENDIX 6. WATER CHEMISTRY RESULTS FOR KENNINGTON PIT

Determinand	25/11/1993	5/3/1989
pH	7.9 ± 0.3	8.9
Biochemical Oxygen Demand (5 day ATU) (mg/l)	2.9 ± 0.1	nd
Ammoniacal nitrogen (mg/l)	<0.05	nd
Unionised ammonia (as nitrogen) (mg/l)	<0.001	nd
Total oxidised nitrogen (mg/l)	1.2 ± 0.1	3.0
Chloride (mg/l)	41 ± 1	54
Soluble reactive phosphate phosphorus (mg/l)	<0.06	nd
nd = not determined		

**APPENDIX 7. PHOTOGRAPHS OF SITES SEARCHED FOR THE
GLUTINOUS SNAIL**

Photograph 1 **Hinksey Stream at Devil's Backbone bridge (SP511044). Site of 1857 record. Looking upstream.**



Photograph 2 **Hinksey Stream at Devil's Backbone bridge (SP511044). Site of 1857 record. Looking downstream.**



Photograph 3 **Kennington Pit (SP51870339). Looking across bays 1, 2, 3 and 4. (4 is nearest).**



Photograph 4 **Kennington Pit (SP51870339). From Bay 3, looking across to bays 4, 5 and 6.**



Photograph 5 Ditch next to Kennington Pit (SP519033).



Photograph 6 Ditch next to Kennington Pit (SP519033).

