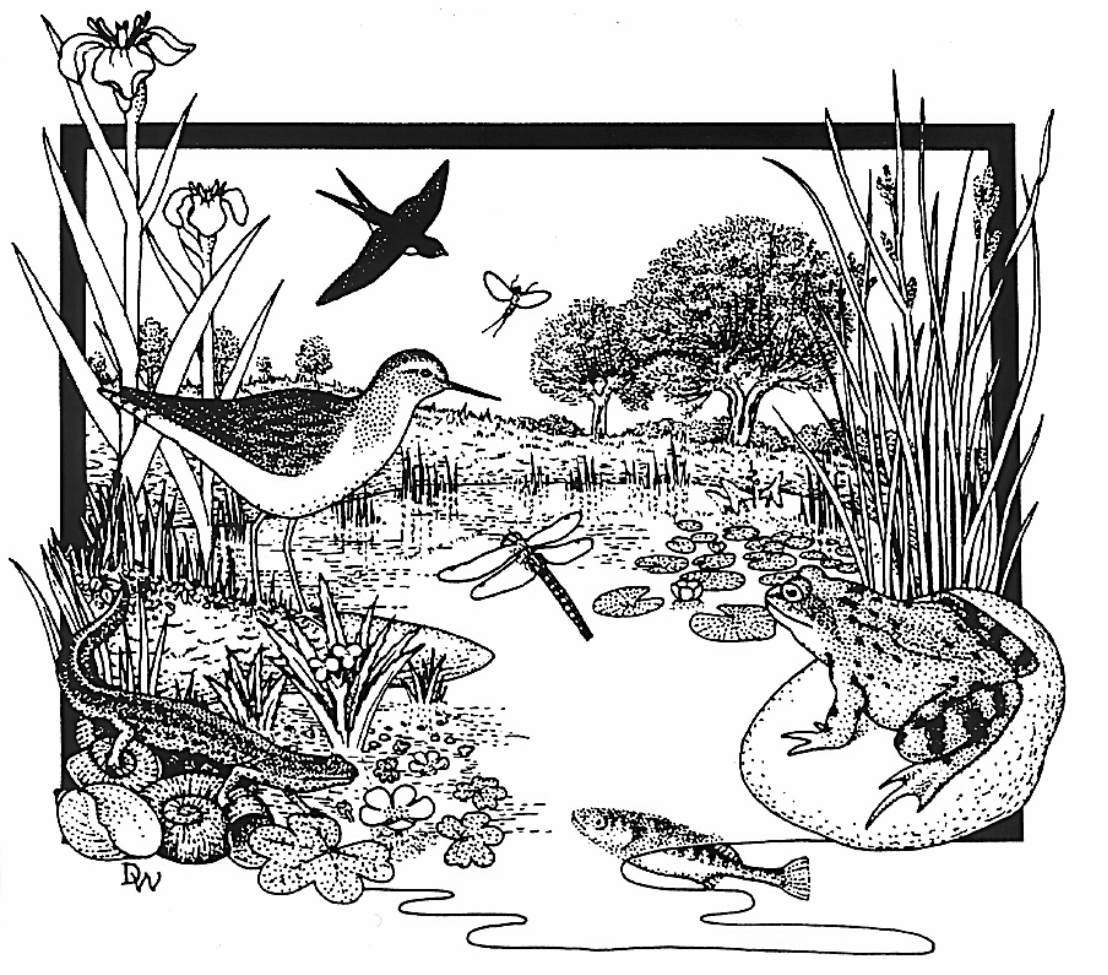
The ecology and management of

New Pond, Gerrards Cross



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Ecology and management of New Pond, Gerrards Cross

Summary of findings

The results of an ecological assessment of New Pond, Gerrards Cross showed that the pond had an unexpectedly high value. The invertebrate animal fauna was exceptionally rich in species and supported a number of uncommon and Nationally Scarce species, including the Downy Emerald dragonfly (*Cordulia aenea*). The plant community was also rich and supported a number of locally common species. Starfruit (*Damasonium alisma*) was not recorded in the survey.

The future management of the pond should present relatively few conflicts between (i) the likely management requirements for Starfruit (ii) management for other plants and invertebrates, and (iii) Gerrards Cross community interests.

The most urgent requirement is to protect the pond community as a whole by eradication of the invasive alien plant species New Zealand Pigmyweed (*Crassula helmsii*) from the site. Rapid action is needed since the species is just beginning to become established. In one or two years it is likely to be pervasive and both difficult and expensive to eradicate. Both Starfruit and other pond species would be likely to be adversely affected if *Crassula* continues to grow unchecked.

Ecology and management of New Pond, Gerrards Cross

1. Aim of the report

New Pond is one of the few remaining British sites for the Red Data Book plant Starfruit (*Damasonium alisma*). The pond is also an important local landscape feature within Gerrards Cross. Currently, however, there is little information about the overall ecological value of the site. This makes it difficult to define a suitable pond management regime and, in particular, to identify whether management for amenity purposes or to encourage Starfruit propagation, might be damaging to other aspects of the wildlife community.

This report describes the results of an ecological survey of New Pond undertaken by Pond Action for Gerrards Cross Parish Council in July 1999. The report:

(i) describes the results of surveys of the wetland plants, aquatic macroinvertebrate and amphibian communities,

(ii) provides an assessment of the pond's overall ecological quality, and

(iii) gives management recommendations which aim to help maintain the pond's wildlife value.

2. Site location and surrounds

New Pond (SU 999883) lies on Gerrards Cross Common adjacent the A40 in Gerrards Cross, Buckinghamshire. The pond is surrounded on three sides by common land now overgrown with secondary woodland. To the south-west, the fourth side of the pond borders the A40, with suburban housing beyond.

3. Geology and water source

The 1:50,000 geology map for the Gerrards Cross area shows that New Pond is dug into a surface layer of glacial sands and gravels. Nineteenth century records from the excavation of a well at a location approximately 30 yards north-west of New Pond report that "Seven or eight feet of variously mottled clays were seen beneath six feet of brownish gravel."[1] This suggest that the glacial gravels directly overlie more clayey strata, probably Reading Beds.

The implication from the surface geology is that New Pond is largely fed by a groundwater aquifer which fills the gravels - a similar situation to the nearby Latchmoor Pond (Pond Action 1998). The gravel aquifer is shallow and 'perched'; held up above the impermeable natural clay layer of the Reading Beds. In addition to groundwater, the pond is also partly fed by (i) run-off water draining from higher ground on the common (ii) runoff from the road, entering via two road drains and (iii) by direct precipitation of rainwater. Groundwater is, however, likely to be the dominant water source.

[1]Grid reference approximately SP998883. Whittaker, W. (1872). *Memoirs of the geological survey of England and Wales. Vol IV*. Longmans, London.

4. Physical characteristics of New Pond

New Pond is a moderately large waterbody, c.0.4 ha in area. Approximately 30% of the pond margins are shaded by oak, birch and willow trees. The heaviest shade occurs along the north-west and south-east banks where willows overhang, and locally grow in, the pond. Most of the central areas of the pond are unshaded, and overall only about 8% of the pond as a whole is directly overhung by trees.

The height and angle of the pond banks varies around the pond. To the south-west and along the road margin, the banks are low (c. 0.4 m above water level) but they rise almost vertically from the pond base. Around other margins, particularly to the north-east, the banks are higher (up to 0.8 m) but have a shallower gradient, often with a wide low-angled drawdown zone along the pond edge.

On the date of the survey, the pond had water depths of up to 0.5 m (average 0.35 m). On-site evidence suggested that winter water depths in the pond would normally be approximately 0.3 m deeper than this. Most areas of the pond had relatively little bottom sediment. The average sediment depth was only 0.1 m; however, there were local accumulations of silt up to 0.4 m deep.

The water pH was slightly acid (pH 6.2). This is what would be expected for ponds with good water quality on the sandy soils of the Gerrards Cross area (see also Section 7.2.4).

5. Ecological survey of New Pond

5.1 Methods

The pond was surveyed for plants, invertebrates and amphibians by Pond Action on 29th July 1999. An additional check was made for Starfruit by Penny Williams (Pond Action) and Belinda Wheeler (Plantlife) on 29th August 1999. The methods used for the survey were based on standard techniques used for the National Pond Survey. Data from the site were compared with other sites from the UK which were surveyed using the same methodology.

The methods used to undertake the survey are described in Appendix 1. In brief, invertebrates were surveyed by taking a standard hand-net sample from the main pond habitats. This sample was then sorted in the laboratory to remove invertebrate species for identification. Wetland plants were surveyed by walking and wading the perimeter and open water areas. Amphibians were searched for around the edge of the pond and by hand netting in the water.

5.2 Conservation assessment methods

The ecological value of the site was assessed using two methods.

1. Conservation value

The pond's conservation value was assessed in terms of:

(i) the number of species of plants, invertebrates and amphibians recorded at the site,

(ii) the number of uncommon species present.

2. Ecological quality

An overall ecological quality assessment was also made to assess whether the wildlife community has been damaged by factors such as pollution or poor bank structure. This method uses slightly different measures to those used to assess conservation value, focusing particularly on biological factors (such as the number of dragonfly families) which are known to be susceptible to pollution and other forms of degradation.

The following sections focus on describing the conservation value of the site with a brief summary of the pond's ecological quality. The ecological quality results are given in more detail in Appendix 5.

5.3 Wetland plant survey results

A list of the wetland plant species recorded from the pond is given in Appendix 2.

Number of wetland plant species

New Pond had a rich wetland plant community, with 32 species recorded from the site. This total is well above the average for countryside ponds. The recent DETR[2] Lowland Pond Survey, for example, recorded an average of only 10 wetland plant species per pond in the lowland countryside (Williams *et al*. 1998). New Pond is also well above average when compared with ponds in Pond Action's national survey of *high quality* ponds mainly located on nature reserves across Britain (see Appendix Table 4.1).

Uncommon plant species

Starfruit was actively searched for at the pond but was not seen during either the July or August surveys. No other rare or nationally scarce plant species were recorded. However, three plant species occurred which currently have a rather restricted distribution in Britain and can be regarded as 'local'[3] at a national level. These 'local' species were:

(I) Lesser Marshwort (*Apium inundatum*): a species which avoids highly enriched waters. In New Pond it occurred mainly around the NE and SE edges of the pond, growing in shallow water, often in areas beginning to be overgrown by *Crasssula*.

(ii) Water-purslane (*Lythrum portula*): a species typical of more acid sites. In New Pond its distribution is similar to Lesser Marshwort, but it typically grew higher on the bank, in the area of seasonally fluctuating water levels (drawdown zone).

(iii) Trifid Bur-marigold (*Bidens tripartita*): an annual marginal plant which typically colonises bare or disturbed ground. In New Pond it was growing fairly extensively along the broad north-east drawdown zone of the pond.

[2]DETR: Department of the Environment, Transport and the Regions

[3]Nationally 'local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in the UK (i.e. less than 700 10 x 10 km squares).

Additional characteristics of the plant community

The plant community supported a range of species often associated with acid heathland sites in lowland England. This included Bulbous Rush (*Juncus bulbosus*), Lesser Marshwort (*Apium inundatum*), Water-purslane (*Lythrum portula*), Purple Moor-grass (*Molinia caerulea*) and Velvet Bent (*Agrostis canina*). The occurrence of these species contrasts with nearby Latchmoor Pond which is now dominated by much more nutrient loving, eutrophic species (Pond Action 1998).

The richest areas of the pond for plants were the lower slopes and shallow water areas of the north-east bank. Most of the species present in the pond were found in this area and many were restricted to it. The richness of this area can be attributed to (i) the occurrence of a broad low-angle drawdown zone with seasonally fluctuating water levels which is ideal for germination and growth of marginal wetland species; (ii) the moderate disturbance caused by people, allowing low-growing wetland herbs to thrive; and (iii) only moderate levels of tree shade.

In other parts of the pond, plant diversity was moderate. The least diverse areas were (i) the central open water areas, which supported only waterlily and the common aquatic moss *Drepanocladus revolvens*, and (ii) the 'front' of the pond adjacent to the road, which largely supported stands of Common Reed (*Phragmites australis*) with some Water Mint (*Mentha aquatica*).

Invasive alien plant species

Three alien wetland plant species were recorded at the pond: Duck-potato (*Sagittaria latifolia*), American Willowherb (*Epilobium ciliatum*) and New Zealand Pigmyweed (*Crassula helmsii*).

Of these, the most worrying is New Zealand Pigmyweed (*Crassula helmsii*)[4]. This is a highly invasive plant which can out-compete native species and lead to considerable loss of biodiversity from a pond. At New Pond *Crassula* occurs mainly in patches running south-eastwards from the area in front of the seat on the NE bank. Within this area it occurs in a 10 m x 3m band in shallow water (5-10 cm deep). These colonising plants are very close to the area where Starfruit has been recorded in previous years.

In addition to the main plant clumps, occasional fragments of *Crassula* were found floating in other areas of the pond. From the size and distribution of the *Crassula* stands it looks as if the species had been growing in the pond for about 2 years.

5.4 Aquatic macroinvertebrate survey results

Number of aquatic invertebrate species recorded

A total of 69 aquatic macroinvertebrate species were recorded from the pond. This is a *very* high total, which is in the top 3% of our National Pond Survey (NPS) sites. The NPS was itself a survey of high quality ponds (mainly ponds in nature reserves), so New Pond clearly has an exceptionally rich invertebrate community.

The water beetle and water bug faunas were particularly rich (32 and 15 species respectively). There was also a good dragonfly community with six breeding species

[4]Sometimes also called Australian Swamp Stonecrop.

recorded (i.e. species recorded as larvae, as opposed to adults which could be just flying over). The number of water snail and limpet species in the pond was relatively low (only 3 species); this is typical and natural for more acid sites which have little calcium available for shell growth.

Appendix 3 gives a list of all the aquatic macroinvertebrate species recorded from the pond. Appendix Table 4.2 gives the species totals from other surveys which can be used for comparative purposes.

Uncommon and specialised aquatic invertebrates

Four Nationally Notable invertebrate species were recorded from the pond. All were species of water scavenger beetle. These were: *Hydrochus angustatus, Helochares punctatus, Hydaticus seminiger* and *Hydraena testacea* (none have English names). In addition the uncommon dragonfly, the Downy Emerald (*Cordulia aenea*) was recorded. This species occurs only very locally in the UK and is mainly concentrated south of the Thames, but with scattered populations north to the Scottish Highlands (Brooks 1997).

A distinctive feature of New Pond's invertebrate community was that a relatively high proportion of its species had very specific habitat preferences either for (i) factors associated with *overhanging trees* such as shade or the presence of leaf detritus, or (ii) for factors associated with *acid heaths* (e.g. relatively low pH water, presence of *Sphagnum* mosses etc).

In particular, three of the four Nationally Notable species present at the site had preferences for one or other of these habitats. These were:

Nationally Notable species	*Habitat preference*
Hydrochus angustatus	Heathland ponds
Helochares punctatus	*Sphagnum* moss and acid water
Hydaticus seminiger	Shaded ponds

In addition, the uncommon Downy Emerald dragonfly has preferences for both sheltered woodland ponds with overhanging trees *and* relatively acid water. The reason for this is that its larvae live amongst *coarse* leaf litter on the pond bottom. They are not found amongst submerged aquatic plants and avoid exposed silt or gravel and nutrient rich water. As an adult, the Downy Emerald is largely confined to patches of mature woodland and will not readily leave the woodland canopy (Brooks 1997).

The richest habitats in the pond for invertebrates

In terms of the most diverse areas of the pond for aquatic invertebrates, two habitats stood out as being exceptional. These were:

- *The clumps of Soft Rush with low growing grasses, particularly in the northern tip of the pond*. This habitat of clumps of rush in very shallow water, only a centimetre or so deep, is always a very valuable habitat type in a pond, especially for water beetle species. New Pond had unusually good expanses of it.
- *The trees and shaded areas, particularly where the willow branches dipped into the water*. As noted above, the tree shade and leaf litter were important for a number of invertebrate species in the pond. In addition, willows are unusual amongst tree species in that their branches root where they touch water creating a complex underwater habitat

of tangled root masses. In New Pond this habitat was much used by water beetles, water bugs and newts.

Other habitats in the pond, such as the stands of Common Reed, Bulrush and White Water-lily were moderately valuable, but much less species-rich habitats.

5.5 Amphibians

Newt larvae were very common in the pond, with hundreds netted. All larvae were too small to identify with certainty. However they were either Smooth or Palmate newts (*Triturus vulgaris* or *T. helveticus* respectively). Within the pond, newts were found most commonly in shallow water on the north-east margin and amongst tree roots in more shaded areas. Note also that the timing of the survey was not optimal for amphibians, and that additional species might use the pond in spring. It would be expected that the Common Frog (*Rana temporaria*) would breed at the pond, for example.

Single sightings of Kingfisher, Coot and Mallard were also made at the pond.

5.6 Conclusions: overall conservation value of the pond

Overall, the pond had a very high conservation value, with a rich plant community and an unusually rich invertebrate community, including four Nationally Notable species and an uncommon dragonfly. The pond also included a range of species which have a preference for rather acid water with low nutrient levels or for ponds with shaded margins. Most of the uncommon and local plant and animal species present at the site were dependent on one-or-other these conditions.

6. Assessment of the ecological quality of the pond

As described in Section 5.2 above, the ecological quality of the pond was assessed to see if its wildlife community had been damaged by factors such as pollution or poor bank structure. The method used for this assessment is called PSYM (the Predictive System for Multimetrics, pronounced ‘sim’). This is a predictive method which takes simple environmental variables from the pond (e.g. pond area) and uses these to calculate which plants and animals should be present in the pond if it is in top condition. More detail about both the method and the findings at New Pond are given in Appendix 5.

In summary, the PSYM findings for New Pond suggests that the site is currently in excellent condition.

7. Management recommendations for New Pond

7.1 Background

The survey findings and future management of the pond were discussed in an on-site meeting between Elspeth Gaylard (Gerrards Parish Council), Belinda Wheeler (representing Plantlife) and Penny Williams (Pond Action) on 31 August 1999. The recommendations given below arise from discussions at that meeting. They address, in particular:

- Management to maintain the pond's high quality plant and animal community as a whole.
- The likely effect of Starfruit management on the rest of the plant and animal community.
- The possible effect of amenity management on the plant and animal communities.

Detailed recommendations for the management of Starfruit are not addressed here since this advice is being provided by the Starfruit UK Steering Group.

7.2 Management for the plant and animal community as a whole

7.2.1 Overview

The pond currently has a very high ecological quality which it is well worth trying to maintain and protect. The main focus should therefore be on maintaining the current quality and range of habitats present in the pond, particularly by:

1. Protecting the two critical *habitats* at the site from damage i.e.:
   - the overhanging trees, particularly the willows growing at the edge and in the water,
   - the clumps of rushes with low grasses in the northern corner.
2. Managing the site actively to remove the invasive alien species *Crassula helmsii*.
3. Protecting the site from potential threats to its *water quality* by reducing drainage of road runoff into the pond if possible, and preventing any greater duck numbers from using the pond.

These three aims are discussed further below.

7.2.2 Protecting critical habitats

As noted above, New Pond has two habitats (i) the overhanging trees and (ii) clumps of rushes in the northern corner, which are important for maintaining the ponds high quality invertebrate community.

The future management of the site needs to ensure that these habitats are maintained and, in particular, not damaged by management or removal. In practice, the main risk is that the existing overhanging willows might be cut back to allow more light to get to the margins of the pond or to create better views over the water.

It is clear from on-site evidence that coppicing has already taken place around the pond in recent years, particularly on the eastern bank where Starfruit occurs. Future coppicing in this area may be necessary in order to trim back re-growth to maintain these unshaded margins for Starfruit. Further coppicing to extend the unshaded margins should be avoided however, since it is highly likely to be detrimental to other pond inhabitants. Indeed, it would probably be beneficial if some additional growth of willow was encouraged in other areas of the pond.

In the survey of New Pond only one individual of the Downy Emerald dragonfly was recorded. This suggests that the species may only be present in very small numbers. As noted in Section 5.4, this species requires areas of *coarse leaf-litter* in areas *bare of other*

plants. This is a habitat which is not common at New Pond, and it could be usefully extended. The most effective way of doing so would be to allow the existing areas of trees along the northern and southern edges to *extend further into the water* by allowing willow-boughs to overhanging the water and by encouraging new trees to root directly into the pond. It would not matter if the extension of this habitat replaced some of the tall emergent plants present in the pond (such as the Common Reed or Bulrush stands).

With the exception of the shallow grassy and rushy edges, other habitats in the ponds are far less critical so, for example, removal of some of the water-lilies or aquatic moss for aesthetic purposes or to encourage germination of Starfruit would be unlikely to damage the pond's existing conservation interest.

7.2.3 Removal of Crassula helmsii

New Zealand Pigmyweed (*Crassula helmsii*) is a highly competitive plant species which is a significant threat to the conservation quality of the site. The area at most immediate risk is the plant-rich shallow eastern margins of the pond which includes the area in which Starfruit is recorded.

Rapid action is needed to try and remove this species from the site. The *Crassula* plants are just beginning to become established and in one or two years *Crassula* is likely to be pervasive throughout the pond and both difficult and expensive to eradicate. Both Starfruit and other pond species would be likely to be adversely affected if *Crassula* is not controlled.

In practice there are relatively few options for eradicating *Crassula* from the pond. Information from English Nature and the Institute of Freshwater Ecology suggests two main modes of treatment to eradicate it: (i) herbicide, (ii) covering with black plastic. Neither of these methods is foolproof, however, and repeat treatment should be expected.

The leaflet enclosed ("*Crassula helmsii* - focus on control") provides much useful information but was produced some five years ago and does not give the most up-to-date advice. Hugh Dawson (Institute of Freshwater Ecology), who is the main national authority on *Crassula* control, was contacted to provide direct technical advice.

His view is that covering the area with black plastic or herbicides would both be viable options. Digging out is not recommended because this releases many tiny shoot fragments, which re-root across the pond.

If black plastic is used this needs to be weighed down firmly in the water to prevent light from getting in, and the sheeting from floating. Rolls of black plastic 2m wide are readily, and relatively cheaply, available from builders' merchants.

Hugh Dawson suggest that Diquat is an effective herbicide to use to control *Crassula* (not Glyphosate which is also mentioned in the booklet, but has proved less effective). He reports that recent trials have shown that an effective way of applying the herbicide is to spray in winter. *Crassula* is unusual in that it remains green in winter. So at this time it can be sprayed-out with relatively little effect on the native plants which have already died-back. Seeds of Starfruit would be unlikely to be affected.

Hugh also suggests that two applications, 2 weeks apart, should be 99% effective at removing *Crassula*. The spray should be applied to the water over the *Crassula* plants and in a zone 2m out from them, to ensure that underground rhizomes are killed too. The area of application should be disturbed as little as possible during and after treatment. The herbicide would need to be applied by a registered operator. Diquat is a herbicide which is licensed for use in and near to water; however, the local Environment Agency office should be informed if herbicide control is to be undertaken.

Because of the sensitivity of the site, English Nature and Plantlife would, of course, need to be fully involved in the decision-making process for control of *Crassula* at the site.

As a final point, it was clear on-site that the best stands of the locally uncommon plant Creeping Marshwort (*Apium inundatum*) occurred in the area now occupied by *Crassula*. It would seem appropriate to remove and replant some specimens of this plant before the *Crassula* is managed.

Summary of recommendations for controlling *Crassula* at New Pond

- The most important recommendation for controlling *Crassula* at New Pond is that some immediate action is taken during this autumn or winter.
- Crassula may be controlled by either of two alternative methods:
  (i) black plastic may be a rather less effective method than herbiciding, and the plastic will need to be weighted down and left in place for many months. It would, however, severely weaken the existing stands of *Crassula*.
  (ii) careful herbicide application would need to be undertaken a number of times by a licensed operator in winter. The method is likely to be effective, and current evidence is that *should* not cause any lasting damage to the site's conservation value.
- Because of the sensitivity of the site, it is strongly recommended that action to control *Crassula* is undertaken in consultation with, and preferably under the supervision of, Plantlife and/or English Nature.
- It is recommended that the best stands of Creeping Marshwort (*Apium inundatum*) are removed where they grow within the *Crassula* management area, and are replanted elsewhere on the site.
- It is recommended that there should be no clearance of pond vegetation to encourage Starfruit to germinate until *Crassula* is under control at the site.
- It is important that following the initial action to control *Crassula* at the site, there is continual vigilance in the next few years to tackle new colonies of the plant which are bound to occur. During the field survey, small viable fragments of *Crassula* were seen floating in the water in places around the pond. These were removed, but there are likely to be many more which will root and begin to spread.

7.2.4 Protecting site water quality

There are two main water quality issues at the site. The first is already a problem: road runoff entering the pond from the A40. The second is simply 'flagged-up' here, in case it becomes an issue in future - the introduction of greater numbers of ducks to the pond.

Road runoff problems

Road runoff from the A40 currently enters the pond via two road drains. The first drains water directly into the pond via a new plastic pipe which overhangs the water on the SW bank. The second drain is an older metal pipe which drains water into the woodland edge in the western corner of the pond.

The occurrence of road drains is undesirable in any pond, and particularly at such an ecologically valuable site. The quality of road runoff is always poor, since it is invariably polluted with high loads of organics, together with oils and heavy metals (such as lead and zinc) derived from engine and tyre wear.

On site, it was clear that road runoff pollution was affecting the quality of the pond along the edge nearest the road. This was evident firstly from the sediments here which were contaminated with oil, and secondly from the pond fauna which was highly impoverished in the areas around where the drains entered.

Clearly, many areas of the pond retain a high quality community, so the severest effects of the road run-off appear to be localised. Fortunately the Starfruit and other botanically valuable areas are on the far side of the pond. However, it should be noted that the open water and waterlily habitats were also rather impoverished, and it is possible that the pond sediments are polluted over a wider area than just adjacent to the inflows.

Regardless of the extent of the pollution, however, it is clearly undesirable that polluted road runoff is entering such a high value pond. Ponds suffer particularly from such pollution because, unlike rivers which can at least export their pollutants downstream, the pollutants in pond sediments build up progressively over time, continually increasing the pollution effects.

It is suggested that the Environment Agency is contacted to discuss the problem. Consultation with Plantlife should also be undertaken since the issue of road-runoff is relevant to a number of high quality pond sites, and may be the subject of future discussions with both the Environment Agency and the Highways Agency.

The number of ducks on the site

A final point worth noting is that attempts to increase the number of ducks or other wildfowl on the pond should be resisted, since it would be highly likely to be damaging to the quality of the pond.

The main impacts from unnaturally high numbers of ducks at a pond would be (i) nutrient pollution from duck faeces and (ii) reduction of plant and invertebrate quality through high levels of grazing and trampling at the margins.

Clear evidence of the effects of ducks on a pond can be seen by comparing New Pond (which currently has a small natural duck population) with the nearby Latchmoor Pond which has many.

Superficially, Latchmoor Pond and New Pond are relatively similar ponds in terms of their depth and water source. Latchmoor Pond, however, shows evidence of being polluted (particularly over-enriched) whilst New Pond is much cleaner and has an exceptionally high conservation value.

Thus, in New Pond the water conductivity (a measure of the nutrients and other chemical dissolved in the water) is moderate to low, as it should be (123 μS[5]). In contrast, the conductivity of Latchmoor Pond is unnaturally high for a pond in this area (567 μS). In addition: (i) Latchmoor Pond is much more turbid than New Pond, and (ii) Latchmoor's plants are dominated by species which tolerate over-enrichment.

Many plant and invertebrate species in New Pond, including the Downy Emerald dragonfly (*Cordulia aenea*) would be lost from the site if the pond water was enriched by ducks.

It is important, therefore, that New Pond is maintained in its current natural state, i.e. with a relatively small duck population. Future attempts to introduce greater numbers of ducks, or to feed ducks at the pond, should be strongly avoided.

7.3 Management for Starfruit: any problems for other wildlife?

On-site discussion with Belinda Wheeler (representing Plantlife) suggests that the future management of the site for Starfruit is likely to involve clearing existing plants from a portion of the shallow water and drawdown area of the pond. The area involved would probably be in the order of $10m^2$ and lies in front of the seat, in the part of the pond where Starfruit has occurred in previous years. The aim of the work would be to remove plants, particularly the aquatic moss *Drepanocladus revolvens*, to create bare substrates suitable for Starfruit germination.

In terms of its effect on other parts of the pond community, this management operation would not be likely to cause significant damage: the moss (*Drepanocladus revolvens*) which is the main plant present in the clearance area is a nationally common species, and it occurs frequently across the pond. Other plants present in the management area (e.g. Gypsywort *Lycopus europeus*, Bulbous Rush *Juncus bulbosus*, and Water-purslane *Lythrum portula*) are also present in other parts of the pond so their populations are unlikely to suffer in the long term. Some species, such as Trifid Bur-marigold *Bidens tripartita*, are likely to benefit from the disturbance.

In terms of the invertebrate community, the likely clearance area did not provide a particularly diverse or uniquely valuable habitat for invertebrates, and its management would be highly unlikely to affect the quality of the invertebrate community as a whole.

[5]μS = microSiemens, a measure of the electrical conductivity of water. The higher the conductivity, the higher the concentration of dissolved chemicals in the water.

The most likely negative effect of the clearance is that the expanse of bare ground would be likely to promote further unhindered growth of *Crassula helmsii* in this area if the species is not controlled.

7.4 Management for amenity: effects on wildlife communities

Discussion with Elspeth Gaylard (Gerrards Cross Parish Council) suggests that the most likely management at the pond for amenity purposes is the management of Common Reed (*Phragmites australis*) to provide better views of the pond from adjacent houses. The management involved is relatively small-scale, limited to cutting down the narrow belt of Reed along the SW bank adjacent to the road. This is unlikely to cause damage to the pond's aquatic macrophyte or plant community since this section of the pond is poor for wildlife and very little of the reed grows in the water to provide an aquatic habitat.

7.5 *Summary of management recommendations*

- Control New Zealand Pigmyweed (*Crassula helmsii*) at the site - ***urgent.***
- Remove or reduce road runoff into the pond (Contact Environment Agency, liaise with Plantlife).
- Maintain existing areas of tree shade and rushes. Expand area of willow growth further into the pond if possible.
- Discourage feeding of ducks, or other attempts to encourage greater numbers of wildfowl to the pond.

APPENDICES

Appendix 1. Survey methods

The methods used to survey the pond were based on methods developed for the National Pond Survey initiated by Pond Action in 1989. National Pond Survey methods have subsequently been used as the basis for many other regional and national surveys including DETR's Lowland Pond Survey 1996 (Williams *et al.*, 1998) and Pond Action's national survey of degraded ponds. A full copy of the methodology is given in Pond Action 1994. Modified extracts which describe the field sampling protocol are given below.

Summary of pond survey procedure

The following list gives a broad outline of the information gathered at each pond.

- A description of the main physical features of the pond and its surroundings together with notes about the age, history and management of the pond.
- Water chemistry: pH and conductivity using field meters.
- A list of the wetland plant species found within the outer boundary of the pond, together with estimates of the abundance of species or major vegetation stands which occupy more than 5% of the pond.
- A list of the species of macroinvertebrates recorded from the pond with estimates of their abundance.
- Notes on the presence of amphibians and fish.

The methods used for collecting biological data are outlined in more detail below.

Recording wetland plants

The main aim of plant recording is to make a complete list of the *wetland plant species*[6] present within the *outer edge* of the pond[7]. Wetland plants are recorded by walking and wading around the margin and shallow water areas of the pond. In deep water aquatic plants are surveyed using a grapnel thrown from the bank and/or boat.

Sampling aquatic macroinvertebrates

The main aim of invertebrate sampling is to obtain, within the sampling time, as complete a species list as possible for the pond,

The pond is sampled, using a hand net, for a total of three minutes (net in the water time). During this time all of the major habitats in the pond are sampled. Examples of typical habitats are: stands of sedge; gravel- or muddy-bottomed shallows; areas overhung by willows, including tree-roots grwoing into the water; stands of submerged aquatics; flooded marginal grasses and inflow areas. The average pond contains 4-10 habitats. Habitats are identified by an initial walk around the pond examining vegetation stands and other relevant features.

Invertebrate sampling is based on the following protocol:

(i) The three minute sampling time is divided equally between the number of habitats recorded: e.g. with six habitats, each is sampled for 30 seconds. Where a habitat is extensive or covers several widely-separated areas of the pond, the sampling time allotted to that habitat is further divided in order to represent it adequately (e.g. into 6 x 5 second sub-samples).

(ii) Each habitat is netted vigorously to dislodge and collect animals. In stony or sandy ponds the substrates are kicked-up to disturb and capture inhabitants.

The three-minute sampling time refers only to 'net-in-the-water' time and does not include time moving between adjacent habitats.

[6]The term 'wetland plant species' refers to species defined as wetland plants on the National Pond Survey field recording sheet list. Terrestial plant species are not recorded.

[7]The 'outer edge' of the pond is defined as the 'upper level at which water stands in winter'. In practice this line is usually readily distinguishable from the distribution of wetland plants or as a 'water mark' on surrounding trees or walls.

(iii) A one minute search (total time, not net-in-the-water time) is made to find animals which may otherwise be missed in the main 3-minute sample. Areas which might be searched include the water surface (for whirligig beetles and pond skaters), hard substrates (for firmly-attached animals), the silty or sandy bottom sediments (for dragonflies and mayflies) and under stones and logs (for limpets, leeches, flatworms and caddisflies).

(iv) Amphibians or fish caught whilst sampling are noted on the field recording sheet and returned to the pond.

Sorting and identifying macroinvertebrate samples

The hand-net samples are sorted in the laboratory to remove invertebrates collected in the net. Samples are sorted 'live' and not frozen or preserved prior to sorting. Samples are sorted as soon as possible after collection, usually within three days of collection.

In general the aim of sorting the sample is to remove and identify all individual invertebrates. In samples where one or two species are present in large numbers (e.g. thousands of specimens), specimens of these species are counted in a subsample and numbers then extrapolated to the whole sample. All specimens of species which cannot be reliably identified in the sorting tray are removed and preserved in alcohol, with the exception of flatworms which are identified immediately. On average, sorting a pond sample to remove invertebrates takes approximately 6-8 hours. Samples containing a considerable amount of algae or duckweed may take considerably longer.

Species which are not immediately identifiable whilst sorting are identified using biological keys and a microscope with a magnification of at least x30. A list of guides is given in Pond Action (1998). Many species (especially the larval stages of insects) cannot be identified below certain sizes. Appropriate sizes are given in identification keys. After identification, invertebrates are returned to a labelled bottle and archived.

Appendix Table 1.1. Macroinvertebrate taxa included in pond surveys

Taxon	*Identification level*	*Notes*
Tricladida	Species	Identified live
Gastropoda	Species	As adults
Bivalvia	Species	Inc. *Sphaerium* spp., but not *Pisidium* spp.
Crustacea (Malacostraca)	Species	As adults
Hirudinea	Species	Identified live
Ephemeroptera	Species	As larvae
Odonata	Species	As larvae
Megaloptera (inc. spongeflies)	Species	As larvae
Hemiptera	Species	As adults
Coleoptera	Species	As adults
Plecoptera	Species	As larvae
Lepidoptera	Species	As larvae
Trichoptera	Species	As larvae
Oligochaeta	Class	As adults
Diptera	Family	As larvae

Note: watermites, zooplankton and other microarthropods are not included in the survey.

Appendix 2. Wetland plants recorded in New Pond

Scientific name	English name	**National status** (i.e. whether the species is uncommon or non-native)
Aquatic Plants: submerged		
Apium inundatum	Lesser Marshwort	Local
Callitriche stagnalis	Common Water-starwort	Common
Juncus bulbosus	Bulbous Rush	Common
Sagittaria latifolia	Duck-potato	Alien species
Aquatic Plants: floating-leaved		
Lemna minor	Common Duckweed	Common
Nymphaea alba	White Water-lily	Probably introduced to the site
Potamogeton natans	Broad-leaved Pondweed	Common
Emergent plants		
Agrostis canina	Velvet Bent	Common
Agrostis stolonifera	Creeping Bent	Common
Alisma plantago-aquatica	Water- plantain	Common
Bidens tripartita	Trifid Bur-marigold	Local
Carex flacca	Glaucous Sedge	Common
Carex nigra	Common Sedge	Common
Crassula helmsii	New Zealand Pigmyweed	Alien species
Eleocharis palustris	Common Spike-rush	Common
Epilobium ciliatum	American Willowherb	Alien species
Epilobium obscurum	Short-fruited Willowherb	Common
Galium palustre	Common Marsh-bedstraw	Common
Glyceria fluitans	Floating Sweet-grass	Common
Gnaphalium uliginosum	Marsh Cudweed	Common
Hydrocotyle vulgaris	Marsh Pennywort	Common
Iris pseudacorus	Yellow Iris	Common
Juncus articulatus	Jointed Rush	Common
Juncus effusus	Soft Rush	Common
Lycopus europaeus	Gipsywort	Common
Lythrum portula	Water-purslane	Local
Mentha aquatica	Water Mint	Common
Molinia caerulea	Purple Moor-grass	Common
Phragmites australis	Common Reed	Common
Ranunculus flammula	Lesser Spearwort	Common
Solanum dulcamara	Bittersweet	Common
Typha latifolia	Bulrush	Common

Number of submerged plant species:	**4**
Number of floating plant species:	**3**
Number of emergent plant species:	**25**
Total number of plant species:	**32**
Number of "local"[8] plant species:	**3**

[8]Nationally 'local' species are defined here as species which occur in less than about a quarter of all 10 x 10 km squares in the UK (i.e. less than 700 10 x 10 km squares).

Appendix 3. Macroinvertebrate species recorded in New Pond

Scientific name	**English name** (if one exists)	**National status** (i.e. whether the species is uncommon; unless otherwise stated species are common)
Tricladida (flatworms)		
Polycelis tenuis	A flatworm	
Hirudinea (Leeches)		
Erpobdella octoculata	A leech	
Erpobdella testacea	A leech	
Glossiphonia heteroclita	A leech	
Helobdella stagnalis	A leech	
Crustacea (Crustaceans)		
Asellus aquaticus	A water slater	
Crangonyx pseudogracilis	A freshwater shrimp	
Gastropoda (Snails/limpets)		
Ferrissia wautieri	A freshwater limpet	
Physa (acuta type)	A bladder snail	
Planorbarius corneus	Great Ramshorn	
Ephemeroptera (Mayflies)		
Cloeon dipterum	Pond Olive	
Megaloptera (Alderflies)		
Sialis lutaria		
Odonata (Dragonflies and Damselflies)		
Aeshna mixta	Migrant Hawker	
Cordulia aenea	Downy Emerald	Nationally Scarce
Ischnura elegans	Blue-tailed Damselfly	
Lestes sponsa	Emerald Damselfly	
Pyrrhosoma nymphula	Large Red Damselfly	
Sympetrum striolatum	Common Darter	
Aranaeae (Spiders)		
Argyroneta aquatica	Water Spider	
Hemiptera (Water bugs)		
Callicorixa praeusta	A lesser waterboatman	
Corixa panzeri	A lesser waterboatman	
Corixa punctata	A lesser waterboatman	
Hebrus ruficeps		A locally uncommon species
Hesperocorixa castanea	A lesser waterboatman	
Ilyocoris cimicoides	A saucer bug	
Nepa cinerea	Water Scorpion	
Notonecta glauca	A greater waterboatman	
Notonecta marmorea	A greater waterboatman	

(Continued)

Appendix 3. (continued). Macroinvertebrate species recorded in New Pond

Scientific name	**English name** (if one exists)	**National status** (i.e. whether the species is uncommon; unless otherwise stated species are common)
Notonecta obliqua	A greater waterboatman	
Plea leachi	Lesser Backswimmer	
Ranatra linearis	Water Stick-insect	
Sigara distincta	A lesser waterboatman	
Sigara dorsalis	A lesser waterboatman	
Sigara fossarum	A lesser waterboatman	
Trichoptera (Caddis flies)		
(Note: English names are those used by fishermen, which sometimes refer specifically to the adult insect rather than the larva. This survey, of course, recorded only larvae; however, no other English species names exist for this group.)		
Athripsodes aterrimus	Brown Silverhorn	
Glyphotaelius pellucidus	Mottled Sedge Fly	
Leptocerus tineiformis	A cased caddis fly	
Limnephilus vittatus	A cased caddis fly	
Mystacides longicornis	Grouse-wing	
Oecetis ochracea	Longhorn Sedge Fly	
Triaenodes bicolor	A cased caddis fly	
Coleoptera (Beetles)		
Agabus bipustulata	A diving beetle	
Agabus nebulosus	A diving beetle	
Agabus sturmi	A diving beetle	
Anacaena globulus	A water scavenger beetle	
Anacaena limbata	A water scavenger beetle	
Anacaena lutescens	A water scavenger beetle	
Coelostoma orbiculare	A water scavenger beetle	
Colymbetes fuscus	A diving beetle	
Copelatus haemorrhoidalis	A diving beetle	
Cymbiodyta marginella	A water scavenger beetle	
Enochrus coarctatus	A water scavenger beetle	
Enochrus testaceus	A water scavenger beetle	
Haliplus ruficollis	A crawling water beetle	
Helochares punctatus	A water scavenger beetle	Nationally Scarce
Helophorus brevipalpis	A water scavenger beetle	
Helophorus minutus	A water scavenger beetle	
Hydaticus seminiger	A water scavenger beetle	Nationally Scarce
Hydraena testacea	A water scavenger beetle	Nationally Scarce
Hydrobius fuscipes	A water scavenger beetle	
Hydrochus angustatus	A water scavenger beetle	Nationally Scarce
Hydroporus angustatus	A diving beetle	
Hydroporus erythrocephalus	A diving beetle	
Hydroporus gyllenhalli	A diving beetle	
Hydroporus incognitus	A diving beetle	

(Continued)

Appendix 3. (continued). Macroinvertebrate species recorded in New Pond

Scientific name	**English name** (if one exists)	**National status** (i.e. whether the species is uncommon; unless otherwise stated species are common)
Hydroporus memnonius	A diving beetle	
Hygrobia hermanni	Screech Beetle	
Hygrotus inaequalis	A diving beetle	
Hyphydrus ovatus	A diving beetle	
Ilybius fuliginosus	A diving beetle	
Laccophilus minutus	A diving beetle	
Nebrioporus depressus	A diving beetle	
Noterus clavicornis	A water beetle	

Total number of invertebrate species recorded: 69

Total number of nationally notable invertebrate species recorded: 4

Appendix 4. Methods for assessing pond conservation value

The following information gives range of data about the conservation value of *other* ponds in Britain. This information indicates the *typical* species richness of ponds in Britain. The data are based on standard National Pond Survey samples of both plant and invertebrate communities in ponds.

Plant data

Appendix Table 4.1. Number of plant species recorded from UK ponds

		Number of species:		
		Marginal plants	Aquatic plants	**Total plants**
National Pond Survey (high quality ponds mostly located in nature reserves*)	Average Range	18 (1-42)	5 (0-14)	**23** (1-46)
Wider countryside ponds (DETR Lowland Pond Survey, Williams *et al.*)	Average Range	8.0 (0-30)	2 (0-10)	**10** (0-35)
Wider countryside ponds (ROPA Survey*)	Average Range	11 (1-32)	3 (0-11)	**14** (1-38)

*The ROPA survey was undertaken by Pond Action with funding from the Natural Environment Research Council.

Invertebrate data

Appendix Table 4.2 Number of aquatic macroinvertebrate species recorded from other UK ponds

		Number of invertebrate species*
National Pond Survey (All ponds were high quality i.e. located in semi-natural areas).	Average Range	**32** (6-98)
Wider countryside ponds (ROPA Survey)	Average Range	**26** (2-64)

* All results are from a single season 3 minute hand-net sample surveys undertaken by, Pond Action.

Appendix 5. Ecological quality assessment of New Pond

5.1 Introduction to the method

PSYM (pronounced 'sim') predicts the plants and invertebrates that would be expected to occur in ponds that are little affected by human impacts (e.g. pollution, land drainage, unnatural numbers of fish or ducks). The predictions are made using simple environmental data about a pond (e.g. pond area, geology, pH). Comparing the predicted flora (and/or fauna) with the plants/invertebrates actually present in the pond provides an objective assessment of the extent to which the pond's is reaching its biological potential.

The degree of impairment is described using three plant and three invertebrate biological measures known to be correlated with different types of environmental impact. These are:

Plants:

(i) Submerged and emergent plant species richness

(ii) Number of uncommon plant species

(iii) Trophic Ranking Score

Invertebrates:

(i) Average Score Per Taxon

(ii) Number of dragonfly and alderfly families

(iii) Number of beetle families

A full description of the PSYM methodology is available in two recent reports for the Environment Agency (Biggs *et al.* 1997; Williams *et al.* 1998[9]).

5.2 Results of pond quality assessment from New Pond

The results from the PSYM assessment are summarised in Appendix Table 5.1. The results from each biological measure are briefly outlined below.

Submerged and emergent plant species richness

At New Pond, the number of submerged and emergent plant species (28 species[10]) was above the number of species which would be expected from the site (22), reflecting the fact that the pond had a rich flora.

Number of uncommon plant species

The number of uncommon plant species recorded from New Pond Pond (3 species) was the similar to the average number predicted for the site (3.6 species).

Trophic Ranking Score

Trophic Ranking Score is a plant-based measure of pond nutrient levels. It is based on the fact that many plants prefer to grow in water or sediments with a restricted range of nutrient levels. Each plant species is given a score (between 1 and 10) depending on whether it prefers low or high nutrient levels. respectively. The average score of all the plants gives an indication of how enriched a pond is in nutrients.

In New Pond the Trophic Ranking Score was similar to what was predicted for the site (7.8 as opposed to the predicted value of 8.2). This suggests that the pond is relatively low in nutrients, as it should be.

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[9]Biggs, J., Corfield, A., Fox, G., Walker, D., Whitfield, M. and Williams, P. (1997). *Biological techniques of still water quality assessment. Phase I Scoping Study.* R&D Technical Report E7. Environment Agency, Bristol.

Williams, P., J. Biggs, M. Whitfield, A. Corfield, G. Fox and K. Adare (1998). *Biological techniques of still water quality assessment. 2. Method development.* R&D Technical Report E56. Environment Agency, Bristol.

[10]Note that this measure excludes floating-leaved species such as waterlilies and duckweed, since these do not have a strong negative relationship with pond quality.

Average Score Per Taxon

ASPT (Average Score Per Taxon) is a measure commonly used in river monitoring. It is calculated as follows. Each invertebrate family has a standard score (between 1-10) depending on its tolerance to organic pollution. The average score from invertebrate families found at a site is the ASPT. In ponds, ASPT is related to many types of degradation including heavy metals and nutrient pollution.

The predicted ASPT value for New Pond was 5.16. This was almost identical to value actually observed at the site (5.10).

Number of Dragonfly and Alderfly families.

It was predicted that New Pond should support 3 families of dragonflies and alderflies. In fact 6 families were observed, indicating a high quality community.

Number of beetle families.

The number of beetle families that New Pond should support was predicted to be 4. In fact 4 families were observed. This measure has a relationship with bank quality as well as water quality, the results suggesting that the bank structure at the pond was good.

Overall quality score

The deviation of the individual measures from the expected values are scored on a 0-4 scale. These scores are added together to give an indication of the overall value of the site. Adding the values together, the overall score for the plants and invertebrates of New Pond is 100% of the potential (24 scored out of a maximum of 24 possible).

Conclusions

The PSYM analysis of the pond communities suggests that New Pond was not degraded in any way by pollution, or affected by poor bank structure. Thus, although the pond is certainly receiving polluted road-runoff, this has not so far accumulated sufficiently to make a difference to the biological quality of the pond.

Appendix Table 5.1. Ecological quality of New Pond

Measure	Observed in the pond	Predicted values from PSYM	Ratio	Score
Plants				
No. of Submerged and emergent plants	28	21.82	1.28	4
Number of uncommon plant species	3	3.64	0.82	4
Trophic Ranking Score	7.80	8.23	0.95	4
Invertebrates				
Average Score Per Taxon (ASPT)	5.10	5.16	0.99	4
Number of dragonfly and alderfly families	6	3.35	1.79	4
Number of beetle families	5	3.83	1.31	4
Total score (out of a maximum possible score of 24)				24
Overall similarity of New Pond to its pristine state				100%

Appendix Table 5.2. Ecological data used for PSYM prediction for New Pond

Variable	*Value entered*	*Variable*	*Value entered*
Altitude (m):	70	Emergent plant cover (%):	18
Easting:	4999	Base clay (1-3)	1
Northing:	1883	Base sand,gravel,pebbles (1-3)	3
Shade (%):	8	Base peat (1-3)	1
Inflow present (0/1):	1	Base rock (1-3)	1
Pond grazed (0/1)	0	Area (m^2)	4225
pH:	6.2		

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