The Bothy Mill Pond – Milland

Project Proposal February 2016

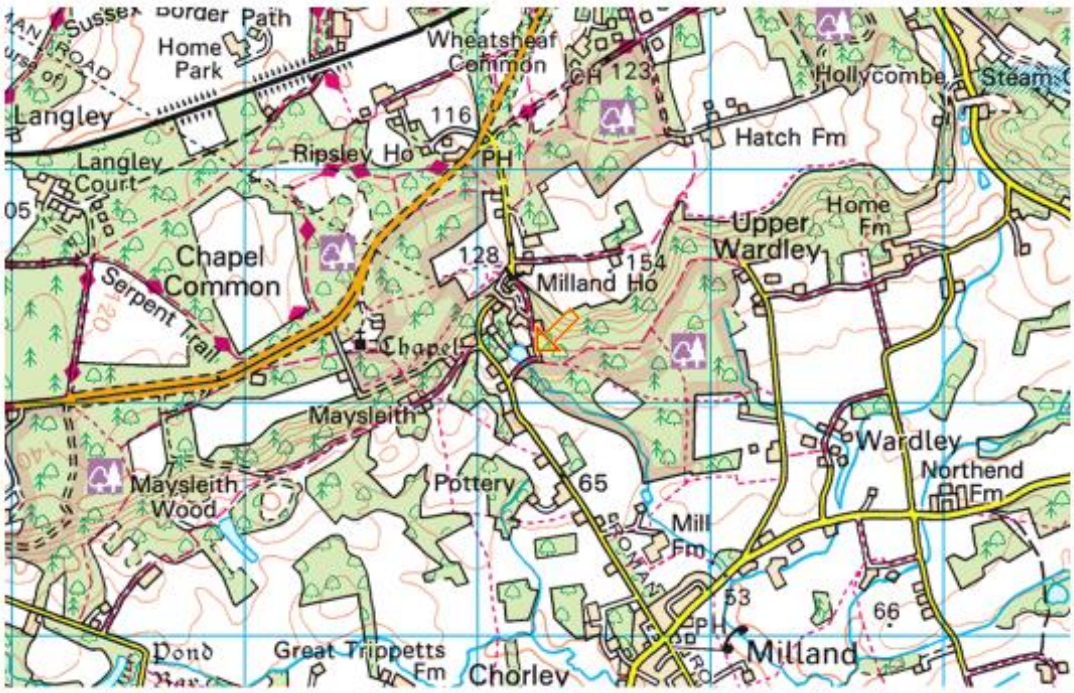
1. Introduction

This report is the output of a site visit to the Bothy Mill Pond, located on the headwaters of the Hammer Stream, near Milland in West Sussex. The site inspected is located virtually at the source of one of the headwater tributaries at National Grid Reference SU 831282. The Hammer stream is a significant tributary of the Western Rother and is considered to be an important spawning and nursery stream.

The Hammer Stream has been assessed under the Water Framework Directive as having only moderate ecological status. The stream is listed by the Environment Agency as Waterbody ID number: GB10704101012820.

The request for the visit came from Mr. Charles Bates who owns the Mill Pond and a short section of stream running both into and out of the pond. The pond supports a wild brown trout *Salmo trutta* population and Mr. Bates is keen to explore options for improved management and maintenance to both protect and enhance this very unusual trout population. Wild trout are commonly found is small still waters in the upland areas of the UK but are rarely found to inhabit the lowland ponds and lakes of central and southern England.

Comments in this report are based on observations on the day of the site visit and conversations with Mr. Bates. Normal convention is followed with respect to bank identification, i.e. banks are designated Left Bank (LB) or Right Bank (RB) whilst looking downstream.



Map1. The Bothy Mill Pond located near the source of the Hammer Stream.

2. Habitat Assessment.

The mill pond at the Bothy was probably constructed to hold a head of water for power production. The name "Hammer" suggests that the stream was certainly used in the medieval iron smelting industry and known sites for iron smelting and processing are located further downstream. It is not entirely clear if the pond at the Bothy was originally constructed as a hammer pond, created to generate power for general milling, or constructed purely for ornamental purposes.

The pond itself is approximately 0.5Ha is size and is fed via a short (approximately 100m) reach of semi natural stream channel, which rises out of spring-head at the source of the system. The comparatively shallow nature of the pond, compared to the dam height, indicates that the bed has slowly risen since its original construction due to the accretion of sediment. This is entirely consistent with all on-line ponds, however, the rate of sedimentation is likely to be very slow in this pond because the inlet stream drains a tiny catchment with very few signs of additional surface water run-off.

Sediment loads within the pond are likely to have been mainly generated from local leaf fall and in-pond weed production and die-back, rather than via extensive surface water run-off from the very limited upstream catchment area above. The spring source itself appears to be very strong and is likely to emanate from a fault line in the local geology, which is a mixture of Greensand and Gault clays. Unlike some local Greensand spring sources, the water does not appear to be particularly iron rich and runs very clear. Some other local spring sources in the Liphook and Milland area are "tea" coloured and are invariably acidic in nature. The spring source here appears to be pH neutral, or possibly slightly alkaline and comparatively low in nutrient loading, with little evidence of excessive amounts of filamentous algae. However, algal growth may be more prevalent during the late spring and summer months. The presence of submerged weeds such as water moss *Fontinalis sp*. and Starwort *Callitriche sp.* indicates a healthy and potentially productive water chemistry.

The vast majority of the pond appears to be less than 1m deep, which would normally indicate a hostile environment for trout, being a cold water species. The proximity of the pond to the groundwater source may well enable the pond to remain relatively cool, even in the height of the summer. That said, maintaining some deeper areas, with a depth of approximately 2-4m would be ideal and ensure a safe refuge area for trout, especially following a prolonged period of hotter than average summer temperatures.

Any removal of accumulated pond sediment is likely to be difficult and extremely expensive. If mechanical removal is not possible and the majority of the sediment is organic then one option is to raise the alkalinity of the bed using porous crushed limestone or chalk to promote a more rapid natural break down of bed material. This material is available as a type of champagne chalk and is marketed under the trade name of Siltex.

This technique can be effective where the water chemistry and bed material is acidic, but the downside is the release of locked-up nutrient from the silt, resulting in either algal blooms, or increased weed growth.

Much of the bank-side trees and shrubs observed are evergreens, with the dam end shaded by a thick, overhanging fringe of what appears to be cherry laurel *Prunus laurocerasus*. The low shady cover provided by the shrubs is excellent, however, the laurel bushes themselves are not considered to be an ideal plant for a pond, or river margin. The leaves of the cherry laurel are known to contain cyanide and benzaldehyde and under certain circumstances have been known to be responsible for fish mortalities. Even if left undisturbed, the leaves that are shed will be very slow to decay, leading to layers of anoxic sediment building up in areas adjacent to the shrubs and also in areas where the prevailing wind blows floating leaves into rafts before they become water-logged and sink.

The bed of any pond under overhanging laurel bushes is invariably going to be a hostile environment for invertebrate production and although the cover afforded by the branches is useful in throwing shade over the water, the Bothy Pond would be a better environment if those shrubs were replaced with low, overhanging native goat willow *Salix caprea*.

Goat willows do not grow into tall trees like white, or crack willow but will require some occasional maintenance. They will, however still provide a thick screen of cover but will also provide a much more productive canopy and root system for both terrestrial and aquatic invertebrates – trout food. If the laurels are to be replaced, care must be taken to avoid too many leaves being dropped into the water and avoid chipping any leaf material in a confined area, or adjacent to the stream below.

3. The Brown Trout Population.

The obvious presence of what appears to be a healthy wild brown trout population in the pond is, to say the least, surprising. The Hammer stream itself is known to support a brown trout population and the lower reaches below Chithurst are also occasionally utilised as a spawning site by sea trout, which actively run the Wester Rother. In a very wet autumn, sea trout have been known to penetrate as far upstream as Sheet on the main river, however; virtually all of the Rother tributaries contribute some production of trout and it is entirely possible that even the resident brown trout populations located above impassable barriers, as is the case on the Hammer Stream, produce some fish that eventually migrate downstream to the sea.

Trout on autumn spawning migrations tend to push upstream as far as they can to utilise favourable spawning sites. It is highly unlikely that any fish are managing to migrate from the Hammer Stream up and into the Bothy Pond to add to the pond's resident population. The height of the dam wall and the configuration of the outlet structure (photo 1) will constitute a significant barrier to upstream migration. Any access for trout into the pond from downstream is highly unlikely and the production of the wild population is therefore restricted to the very short section of inlet channel running up to the spring source.

Brown trout require areas of clean, well-aerated gravel bed to spawn successfully and the amount of suitable habitat for spawning in the stream above the Bothy Pond is very limited. It is possible that the entire population is being supported by just a few square metres of suitable spawning gravels in the inlet stream, which

does make the population extremely vulnerable, should the stream above be modified, or subjected to any changes in management and maintenance.

Ideally the inlet stream should be left in a rough and unmanaged state to provide as much cover as possible and to allow what gravels that do exist to be kept swept clear of fine sediment. Although poorly documented, there is some evidence that brown trout can and do spawn successfully on the gravel margins within the confines of lakes and ponds. This activity is usually associated with natural upland lakes, loughs and lochs rather than man-made lowland lakes; however, the very small amount of gravel bed located at the inlet to the Bothy may well be one of the sites where trout are successfully recruiting. This is an area which potentially could be enlarged and enhanced to create improved spawning opportunities. This is discussed in more detail in the recommendations section below.

Photo 1. The outfall sluice and dam

4. Conclusions

The trout population residing in the Bothy Pond is unusual, interesting and worthy of protection. It is not known if the population has built up over the years as a direct result of natural colonization from a tiny population of wild

fish residing in the very short section of inlet stream, or as a direct result of stocking, either with farmed trout, or by translocating wild fish captured from elsewhere.

These questions could potentially be answered via DNA analysis of Bothy residents, together with samples taken from the stream below. The Victorians were known to be very active fish stockers and it is entirely possible that the Bothy population has managed to become established via fish that started life elsewhere, possibly from a fish farm, or perhaps via wild stocks taken from the Rother, or the nearby River Wey system. Early farmed trout were likely to be fitter and less domesticated than fish available today following many decades of line-rearing and therefore early introductions may potentially have been better equipped for wild survival.

It is more likely that the Bothy fish are originally related to wild stocks of resident brown and sea trout found in the Hammer Stream system itself. Due to their isolation over many years there may well be local adaptation and potentially a genetic study could answer some of these questions but would be expensive. The answers to some of these questions would be of academic interest but fundamentally would not change the fact that a wild population exists and is currently utilising a small and potentially fragile environment. A sensible approach to protecting this population is to ensure that the spawning and nursery habitat that underpins this vulnerable wild stock is preserved and where possible enhanced.

To this end we would recommend that the owners of the stream above are made aware of how important the stream is to the continued success of the wild population locally. Working together with neighbours, it would be possible to improve and protect the critically important sites to ensure that small wild fish continually dribble down the system to populate the Bothy Pond. Equally, the Bothy Pond provides a safe refuge area for fish to grow on into adulthood and provides a source of critically important brood fish that are able to run the inlet stream, spawn and maintain the local population.

It is highly likely that the extent of spawning and nursery habitat for trout fry is the one area which renders the population vulnerable. A project to increase the amount of spawning habitat available should be relatively straightforward and would involve importing suitable mixed angular river gravels in the 10-40mm size range. The brood fish that are present in the Bothy Pond are likely to be of a modest size and may well only utilise the smaller gravel particles when spawning, however, the large pieces are also important for stability and will help ensure that any imported material remains in place.

Due to the small size of the inlet stream, only modest quantities of gravel are required. Care must be taken to ensure that any existing sites suitable

for spawning are not compromised and efforts to create improved habitat concentrated on sections where gravel is either already thin, or non-existent. Lining the neck of the inlet channel with imported gravels could provide additional spawning opportunities but just as importantly could be very important in providing a shallow, well covered refuge area for trout fry emerging from existing spawning gravel located upstream. Any shallow gravel glides and small broken riffles created in the inlet stream must be uneven and liberally covered with natural woody material to maintain a varied bed shape (humpy-bumpy) as well as providing micro habitats for tiny individuals to safely hide.

To give an indication of what might be required. One cubic metre of gravel weighs approximately 1.8 metric tonne. This should be sufficient to line approximately $5m^2$ of channel bed with a mean width of 1m to a depth of approximately 200mm. Within the stream, the spawning glide/riffles should be 3 to 5 times longer than the mean channel width.

It may be necessary to initially remove sediment from selected sites to make space for imported gravels, as the depth of gravel is important. Even in a small stream the gravel should be at least 200mm (below designed bed level) to allow for successful redd (trout spawning nest) creation. If the existing bed sediment is soft then importing the gravel on top can simply displace the existing soft bed material. If the bed material is compacted sand, or clay then this might have to be lowered/removed, either with a small excavator, or even with hand tools to make space for the gravels.

It is possible to have suitable gravel delivered to site in 1 tonne bulk bags. An initial project to line the pond inlet and two or three selected areas in the stream itself would require approximately 5 tonnes of gravel. This could be barrowed into the stream by hand in a single day with a small team of volunteers and might be a project that WTT could help to organise, potentially with the assistance of local voluntary groups.

The inlet stream is not designated as a "main river watercourse" and is therefore not regulated by the Environment Agency under their Environmental Permitting Regulations. As an "ordinary watercourse" a consultation with the local authority is required before any work can be carried out.

5. Recommendations

- Consider the removal of overhanging laurel bushes and replace with low-bushy willows on the pond dam.

- Undertake periodic depth surveys of the Pond and monitor the rate of sedimentation with a few marker posts. Maintaining at least some areas of deeper water in excess of 2m is likely to be critically

important for the long term survival of any trout population in a still water environment, particularly one located in southern England.

- Research the use of Siltex as a method of breaking down sediment layers, particularly beneath existing laurel bushes where bed loads are likely to be acidic.

- Raise awareness about the habitat requirements of the local trout population with your upstream neighbours and encourage a sympathetic maintenance regime, the more relaxed the better!

- Consider enhancing spawning opportunities by importing angular river gravels to create new spawning opportunities in the neck of the inlet stream. If permissions can be gained from the upstream land owner then extending the work to create two or three more spawning and nursey sites in the section of channel upstream will also help to boost recruitment opportunities for the Pond population.

- The WTT can potentially help with a Practical Visit of PV. Further details are available on our website:

  http://www.wildtrout.org/content/river-habitat-workshops-and-practical-visits

6. Making it Happen

The WTT can provide further assistance to help implement the above recommendations. This includes help in preparing a project proposal with more detailed information on design, costs and information required for obtaining consents to carry out the works. If required, a practical visit can be arranged to demonstrate habitat improvement techniques. Demand for these services is currently high but WTT is able to provide further advice and information as required. Further advice on fund-raising can be found at http://www.wildtrout.org/content/project-funding

7. Acknowledgement

The Wild trout Trust would like to thank the Environment Agency for their continued support of the advisory visit service.

8. Disclaimer

accepted by the Wild Trout Trust as a result of any other person, company or organisation acting, or refraining from acting, upon comments made in this report.

We have produced a 70 minute DVD called 'Rivers: Working for Wild Trout' which graphically illustrates the challenges of managing river habitat for wild trout, with examples of good and poor habitat and practical demonstrations of habitat improvement. Additional sections of film cover key topics in greater depth, such as woody debris, enhancing fish stocks and managing invasive species.

The DVD is available to buy for £10.00 from our website shop http://www.wildtrout.org/product/rivers-working-wild-trout-dvd-0 or by calling the WTT office on 02392 570985.

The WTT website library has a wide range of materials in video and PDF format on habitat management and improvement: http://www.wildtrout.org/content/index