Report on Asker, Mangerton and Lower Brit Riverfly monitoring in 2019

Main conclusions

1. The River Asker has the water chemistry expected of a Chalk stream in its headwaters. Further work may establish that many other aspects of the watercourse vary in different locations and so it may be an oversimplification to consider any characteristic typifies the whole of its length.
2. Data collected to date suggests the River Asker supports a high abundance of those invertebrates monitored by the Anglers' Riverfly Monitoring Initiative (ARMI). They have been chosen to detect pollution and estimate the river's capacity to support the food requirements of fish.
3. There would be value in improving PO_4 measurement with an inexpensive colorimeter and extending readings of this important indicator of pollution to the mature segments of the river. Possible additional measurements along the water course could be turbidity, river depth, nitrate levels and possibly flow rate.
4. No survey has been carried out to determine which segments of the river have the physical characteristics required to support a viable population of brown trout. This includes stretches with depths of at least 40 cm and preferably 80 cm, limited disposition of silt and accessibility to areas suitable for spawning.
5. Such a survey might indicate which segments of the river to prioritise for riparian tree management, encouragement of river macrophytes and other modifications that benefit trout populations.
6. It would also be of value to determine the river segments that have sufficient depth for sea trout or salmon which may be greater than required by the smaller, brown trout. This seems to be an important assessment before considering fish passes around current impasses if the access provided is only required to support populations of these migratory fish?
7. ARMI monitoring of the river to date suggests the River Asker has a similar biotic profile to other chalk streams and rivers monitored in Dorset. There is no evidence yet of a pollution concern for the section that flows through Askerswell Parish. It seems to have sufficient abundance of both Baetidae and Caseless Caddis which are the favoured food of the brown trout. The patchy distribution of Gammarus along the River Asker also occurs for other rivers.
8. A Crayfish population is present at the Folly Farm site which may be confirmed as Signal Crayfish. In contrast, crayfish have yet to be recovered above the waterfall at Washingpool and the fast flowing, channelled section through Askerswell village. Consequently the latter upper river segment could provide an ARC site for the White-Clawed Crayfish if the absence of Signal crayfish is confirmed by prolonged sampling.

Physical and Chemical Aspects of the River's Environment

Flow rates.

The overall gradient on the Asker from its source to the Co-op on the outskirts of Bridport is about 1.1%. Some sections characterised with few meanders flow at a high rate than the average. The Frome has an initial gradient of 1.5% but trout occur even within its lower section when the flow is reduced to 0.08%. They tend to congregate in regions of slow flowing rivers where the flow is faster than the average and are dependent on higher flow rates in upper reaches and tributaries for spawning grounds (Mann et al. 1989). Silt deposition is one consequence of a slow flow rate. This will occur when flow rates fall to approximately 0.1cm/second (Fig 1).

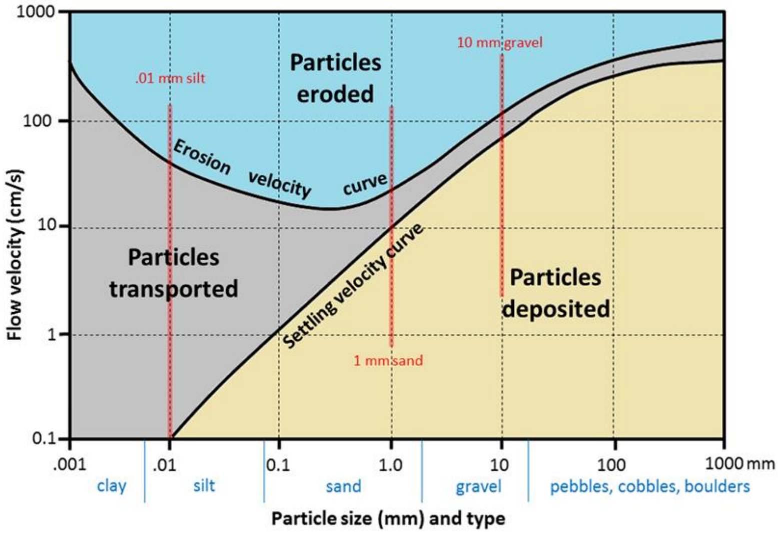

Figure 1: The Hjulström-Sundborg diagram showing the relationships between particle size and the tendency to be eroded, transported, or deposited at different current velocities (https://opentextbc.ca/geology/hjulstrom-sundborg-diagram/).

Water depth

The depth of a small river varies considerably over short distances along its length. An example is provided by study of trout in in winter which was carried out for a river in Berkshire (Fig 5).

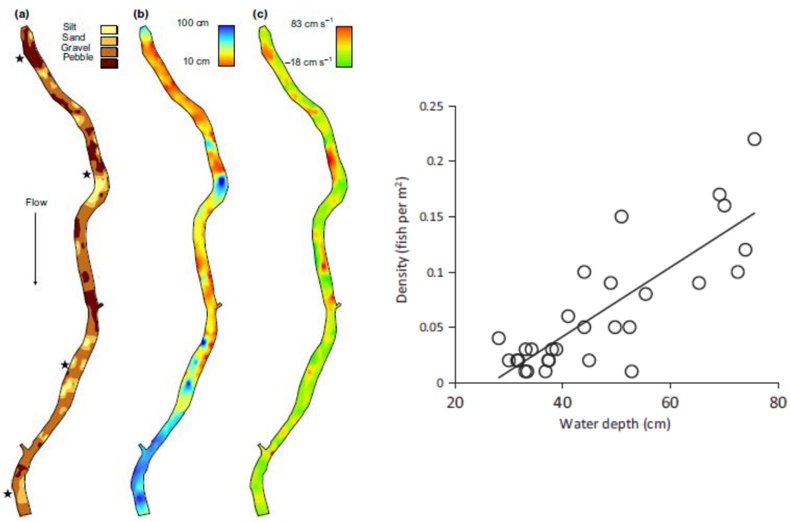

Figure 2: ***Left*: physical** characteristics of a 500m length of the river Lambourn (Berkshire); a, dominant substrate; b, depth and c, river velocity. ***Right***, relationship between water depth and density of trout (Kemp *et al.*, 2017).

This suggests that only segments of the river with an adequate depth of more than 40 cm provide suitable habitat for brown trout. Their needs do vary through the year and they require access to gravel beds or something similar for spawning. They therefore are likely to move their position along the river length during the course of a year.

Water quality

The pH of UK chalk steams is typically pH7.4-8.0 which somewhat lower than measured for that section of the Asker running through Askerswell Parish (Table 1). The temperature range of such streams due to their aquifer origin is 5-17°C which is favourable for both fish and invertebrates. Conductivity has been measured for the River Enborne, a chalk stream in Berkshire. It shows a positive correlation with pH with the means of 477 µS/cm and pH of 7.95 (Halliday *et al*., 2014). This seems consistent with the levels recorded for the Asker which is higher in both pH and conductivity (Table 1).

Table 1: measurement of water quality at two sites on the Asker

Measurement	Above Askerswell Village		Folly Farm	
	06/05/19	04/06/19	07/05/19	04/06/19
Conductivity (µS/cm)	510	550	540	548
Temperature (°C)	7	12	9	11
pH	8.2	8.5	8.4	8.5
PO_4 (see below)	30-100µg/L	c100µg/L	c100µg/L	c100µg/L

The upper favourable level of soluble reactive phosphorus (normally a very similar value to PO_4) has been set by at 40 µg/L for a headwater and 50 µg/L for the main body of a chalk stream/river (JNCC, 2014). Somewhat high values of high, good, moderate and poor quality, of 36, 69, 173 and 1,003 µg/L respectively have been proposed (Water Directive Initiative, 2013). This suggests the Asker, where measured to date, is in the "good" category but does not fall within the lower favourable levels set by JNCC. The limitation is the inexpensive, colorimetric method currently being used for the Asker. It lacks the sensitivity to measure <100ug PO_4/L precisely. There is no clear evidence to-date of PO_4 increasing as the river flows from the eastern to the western sites measured in Askerswell Parish. The monitoring of this pollutant requires extension to cover the whole length of the watercourse.

Biotic aspects of the River's Environment

The river has high score in the riverfly monitoring index. Not all the invertebrates recovered are the favoured food of brown trout. Recovery of stomach contents indicates that 90% of the food of brown trout is provided by Ephemeroptera (54%), Terrestrial animals falling into a river (15%), Chironomids (14%) and Caddis (caseless, 6%). Only the 2 underlined are covered by Riverfly monitoring.

Several of monitoring sites on Dorset rivers in the Riverfly data base belong to a single cluster with Morton Ford and West Stafford differing form the remainder which includes the sites on the Asker (Fig 3).

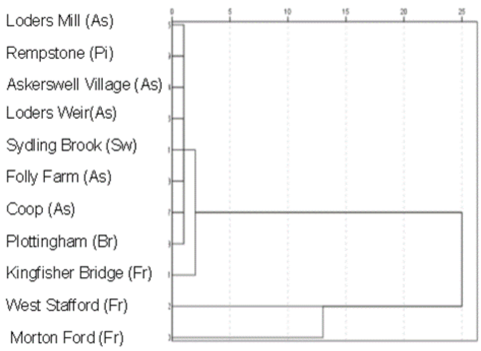

Figure 3: Cluster analysis for rivers in Dorset using Ward's method for Riverfly data collected April or May (one sample/site). The parentheses indicate the river where each site is located as follows: As, Asker; Pi, Piddle; Sw, Sydling Water; Br, Brit and Fr, Frome.

The 5 sites along the Asker provide similar scores in the Riverfly monitoring system except for a lower value at Loders Mill. The abundance of the various invertebrates in the scheme at the 5 sites in April 2019 is given in Figure 4.

Cluster analysis (Fig 5) suggests close relationship in the distribution of 6 of the recovered invertebrates with Gammarus having a distinct profiled in the river and to a lesser extent Baetidae (Olive Ephemeroptera).

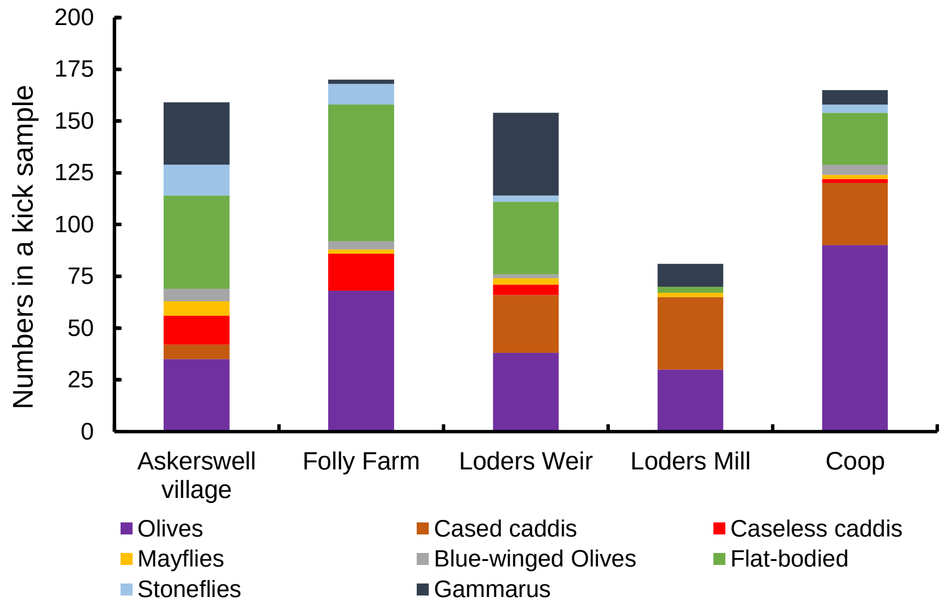

Figure 4: Invertebrates counted at five locations on the River Asker after collection in a standard kick sample taken in April 2019.

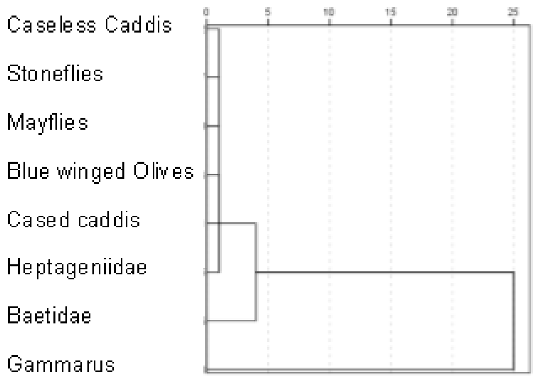

Figure 5: Cluster analysis for differences between collected invertebrates in Riverfly monitoring using Ward's method for data collected April or May (one sample/site)

Gammarus pulex is a widespread Amphipod crustacean with a complex ecology. Its abundance has been related, to the substrate and the presence of bryophytes. It is uses a wide range of food sources including leaves that enter the river and is also capable of being a predator on other invertebrates.

Nymphs of Baetidae typically crawl amongst macrophytes in riffles (shallow sections of a river with coarser deposits). They feed by scraping algae and biofilms from submerged stones and other structures, or by gathering or collecting fine particulate organic detritus from the sediment. They are adversely by pollution, high levels of suspended silt sediment and slow water flows.

Brown Trout food preferences

These fish are capable of feeding on a wide range of invertebrates. They can grow more rapidly than sea trout as they are often associated with rivers and streams with a high abundance of such food. Analysis of stomach contents from a Dorset river in the summer suggest a preference or more frequent access to Caseless Caddis and Baetidae than other aquatic organisms. Caddis and Gammarus are important winter foods.

Table 2: Invertebrates recovered in summer from the stomachs of trout in Beer stream ([†],Mann & Orr , 1969) and from year zero trout in Chalk streams ([‡]Mann *et al.*, 1989).

Invertebrate group[†]	%	Main contributors for the invertebrate group[‡]	
Ephemeroptera	54%	Baetidae	99%
Terrestrial	15%	Diptera, others	
Chironomidae	14%	Orthocladiinae	97%
Caddis	6%	Polycentropus	58%
		Hydroptila	22%

Crayfish in the River Asker

Three very small crayfish were recovered at the Folly Farm site during AMRI kick sampling on 4/06/2019 and again on 10/06/2019 for further imaging using a USB microscope. They are probably young-of-the-year based on their size. Advice was received from Jen Nightingale (Bristol Zoo) via Angus Menzies that they might be White-Clawed crayfish from examining the image in Fig. 6 (left) but positive identification required observation of spines at the cervical groove that occur in White Clawed but not Signal Crayfish. The diagnostic spines have not been detected (Fig 6 right). This suggests they are Signal Crayfish unless the spines are not observable due to the small size of the specimens.

Signal crayfish seems the likely species given a claw of this species has been found c0.5-1km downstream of the sample site. To-date no crayfish have been detected above Askerswell Village on 02/04/19, 06/05/19 and 04/06/19 (i.e. above a 1.5-2 m waterfall and a narrow, fast flowing channelled segment of the river through the village). If Signal Crayfish continue to be absent, then this section of the river could be potential ARC site for White Clawed Crayfish.

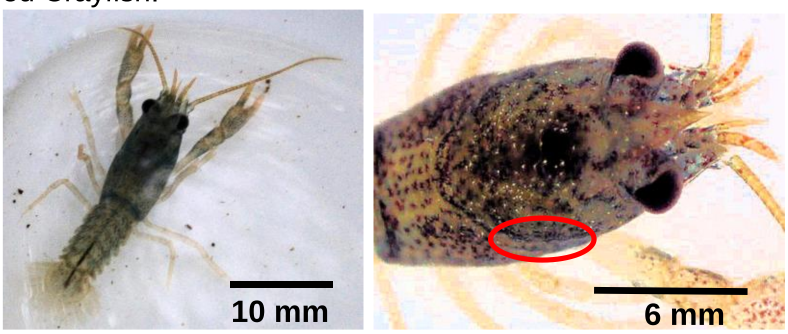

Figure 6: Crayfish recovered during AMRI kick sampling at the Folly Farm site on the River Asker on 4/06/2019. Left, image after recovery, right a second individual recovered on 10/06/2019 in attempt to identify spines at the cervical groove (in area enclosed by red oval).

References

JNNC (2014) Common Standards monitoring guidance for rivers http://jncc.defra.gov.uk/pdf/CSM_rivers_jan_14.pdf

Kemp PS *et al*. (2017) Challenging convention: the winter ecology of brown trout (*Salmo trutta*) in a productive and stable environment. *Freshwater Biology*, **62**, 146–160.

Mann RHK and Orr DRO (1969) a preliminary study of the feeding relationships of fish in a hard-water and a soft-water stream in southern England. *J. Fish Biol*, **1**, 31-44.

Mann RHK *et al*. (1989) The ecology of brown trout *Salmo trutta* in English chalk streams, *Freshwater Biology* **21**, 57-70.

Water Framework Directive (2013) UK Technical Advisory Group: Updated recommendations on phosphorus standards for rivers: River Basin Management. UK (2015-2021). https://www.wfduk.org/sites/default/files/Media/UKTAG%20Phosphorus%20Standards%20for%20Rivers_Final%20130906_0.pdf