ENVIRONMENT AGENCY

AN ECOLOGICAL APPRAISAL OF THE HABITAT AND SPAWNING ACTIVITY OF COARSE FISH OF THE RIVER WENSUM AT TAVERHAM MILL, 2008

SCIENTIFIC REPORT

March 2009

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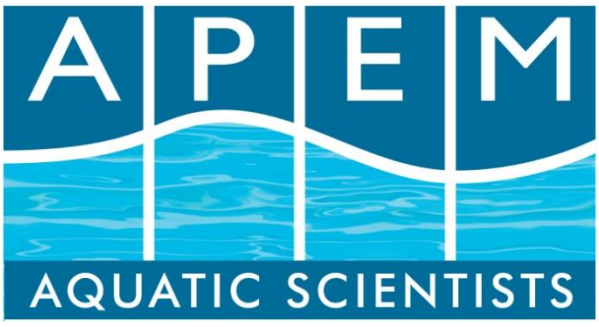

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1.0 INTRODUCTION

A number of fisheries surveys have been performed on the River Wensum in recent years. Although spawning activity of barbel has been recorded at a number of locations in the middle and lower reaches of the river, surveys have failed to detect a single 0+ barbel. As such, information regarding temporal and spatial spawning success of barbel in the river was identified as a requirement to assess the future natural sustainability prospects of barbel stocks in the River Wensum.

2.0 SITE INFORMATION

The River Wensum is the primary tributary of the River Yare in Norfolk. The Wensum flows through Fakenham south-eastwards before joining the Yare just outside Norwich. (Figure 1).

Figure 1. Map showing the location of the River Wensum

3.0 METHODOLOGY

On the 15th May 2008 an ecological walkover was performed at Taverham Mill on the River Wensum near Norwich. The aim of the survey was to map coarse fish habitat and investigate the current utilisation of these habitats for spawning purposes.

In order to account for the temporal uncertainties associated with inter-annual spawning activity, a further survey was conducted in July 2008. This survey focused solely on observations of egg deposition with an objective of determining the distribution and physical characterisation of barbel spawning sites.

3.1 Fish Habitat Walkover Survey

Fish habitat was surveyed during the walkover survey to provide an overall picture of the quality, distribution and relative proportion of coarse fish habitat types available. The general methodology for the walkover survey followed that outlined in the Environment Agency's Fisheries Technical Manual 4 "Restoration of Riverine Salmon Habitats" (Hendry & Cragg-Hine, 1997). The modified technique used during this survey, however, was developed such that it could be used to map the wide variety of habitats used by non-salmonid fish species (Clough, Dennis & Martyn, 2007) in a range of different river types (Table 1).

	Depth (m)			Velocity (m/s)			
	A	**B**	**C**	**1**	**2**	**3**	
Habitat Type	0–0.49	0.5-1.0	>1.0	0.05-0.15	0.16-0.40	>0.4	**Description**
Standing Water (SW)	A-C			0			No perceivable flow, variable depths
Eddy (ED)	A-C			1-3			Vortexing water, mixed flow / depth
Riffle (RI)	A			3			Fast flowing, shallow, broken surface, audible
Glide (GL)	A-C			1-3			Smooth, un-rippled surface, even paced
Run (R)	A-C			1-3			Broken Surface, uneven flow characteristics

Table 1. Classification of habitat type (after Clough, Dennis and Martyn, 2007)

For example, as indicated in Table 1, a section of glide with depth greater than 1m and sluggish flow (0.05-0.15 m/s), typical of a regulated lowland waterway, would be categorised as GLC1. In contrast, a shallow run with depth < 0.5 m and fast flow (0.4 m/s), typical of steep gradient sections of upland rivers would be categorised as RA3. The depth and velocity categories used were comparatively broad, but were selected to reflect the known preferences of some fish species.

The field mapping technique was based upon hand drawing onto a high-resolution map (OS 1 km tiles) at a scale of 1:10,000. The river outline and salient geographic location points were selected from a digital map and printed onto aquatrace (roughly

300-500m of river length per A3 sheet). These maps offer a high level of detail, enabling very accurate mapping of in-river habitat characteristics.

The habitat features noted along the river were drawn directly onto the A3 maps, with the boundaries of the different habitat classifications being drawn to represent their actual position within the river. The symbol was linked to the riverbank delineating the linear extent of that particular habitat feature.

Other prominent features were noted together with trees, electricity pylons and bridges which aided accurate location, the latter being confirmed via hand held GPS. This allowed accurate representation of the areas of individual habitat types encountered. In this manner, a mosaic of the different habitat types was produced for the surveyed section of the river.

On return to the laboratory these data, including photographic records and video footage, were transcribed into GIS (ArcMap) for visual representation as well as facilitating detailed spatial analysis and quantification of habitat types.

3.2 Fish Egg Sampling

Having identified the most likely locations for barbel spawning, a number of sites on the mill stream and main river were sampled by dislodging the gravel substrate and collecting the drift in a dip net positioned immediately downstream

During the June survey, eggs were placed in site specific holding tanks containing well oxygenated river water. The temperature and dissolved oxygen content of this water was constantly monitored to replicate the aquatic conditions of the river. All eggs collected were then taken to the laboratory where they could be incubated and hatched under controlled conditions. During the July survey, eggs and larvae were either identified in the field or fixed in 4 % formaldehyde solution for microscopic examination in the lab.

4.0 RESULTS

Interactive habitat maps illustrating the results of the survey at Taverham can be seen on the accompanying CD using ArcMap – Appendix I. To view footage and images of salient features simply hover the cursor over the centre of the relevant icons until the link appears then, click the icon.

An A3 layout of the survey findings and the fish observed (size represented by the size of the icon) is presented in the Appendix (Fig. A1).

4.1 Walkover survey results

The River Wensum between Taverham Mill (TG 158 137) and Taverham Bridge (TG 160 137) was characterised by fast-flowing, moderately shallow water and diverse aquatic habitat. The river channel was flanked by emergent macrophyte and riparian shrubs along its length. A number of larger willows and bushes were also recorded, particularly on the left bank. Clean gravel and pebble substrates favoured for spawning by a number of coarse fish species were also noted throughout the stretch (Fig.2).

Figure 2. Clean gravel and pebble substrate downstream of Taverham Mill

The weir pool downstream of Taverham Mill was characterised by fast-flowing, turbulent water in excess of 1.5m deep. A sluggish eddy was also recorded, redirecting flow back into the pool. At the tail end of the weir pool the water shallows and the water velocity increases exposing gravel (approximately 20mm diameter). Numerous fish of varying species were observed at this location. In addition, the location of a number of small mid-channel excavations were identified and recorded using a GPS. These excavations were thought to be consistent with coarse fish spawning activities. Submerged macrophytes (broad and fine-leaved) were prevalent in this reach (Fig. 3).

Figure 3. Submerged fine-leaved macrophyte downstream of Taverham Mill

Further downstream a mill bypass channel rejoins the main channel. This increased flow throughout the channel, notably on the right bank of the river where clean gravel was widespread, but interspersed by submerged macrophyte growth. A number of large chub were recorded at this location. These fish were showing signs of pre-spawning congregation.

At the downstream extent of the Taverham survey reach instream macrophytes were sparse and further excavations were noted in areas of shallow, fast-flowing water.

4.2 Habitat Composition

The area of each habitat recorded during the walkover survey at Taverham Mill is shown in Table 2. Moderately fast flowing (0.16-0.40 m/S) water between 0.5 and 1.0m in depth (RB2) was the dominant habitat type recorded. A number of other habitat types were widespread, notably RB3 and RC2. Combined eddy habitat also contributed a notable amount (10 %) to the overall results, although the majority of this habitat was located in the weir pool downstream of the mill.

Table 2. Percentage of instream coarse fish habitat at Taverham Mill (* habitat incorporated into other classifications)

	Area	%
Redd	5	*
Spawning Habitat	148	*
RA1	43	1
RA2	324	8
RA3	460	11
RB2	1980	46
RB3	407	9
RC2	471	11
RC3	26	1
EDB1	38	1
EDC1	309	7
EDC2	82	2
Standing water	39	1
Torrent	141	3
Total	4320	100
Total Run	3711	86
Total Eddy	429	10

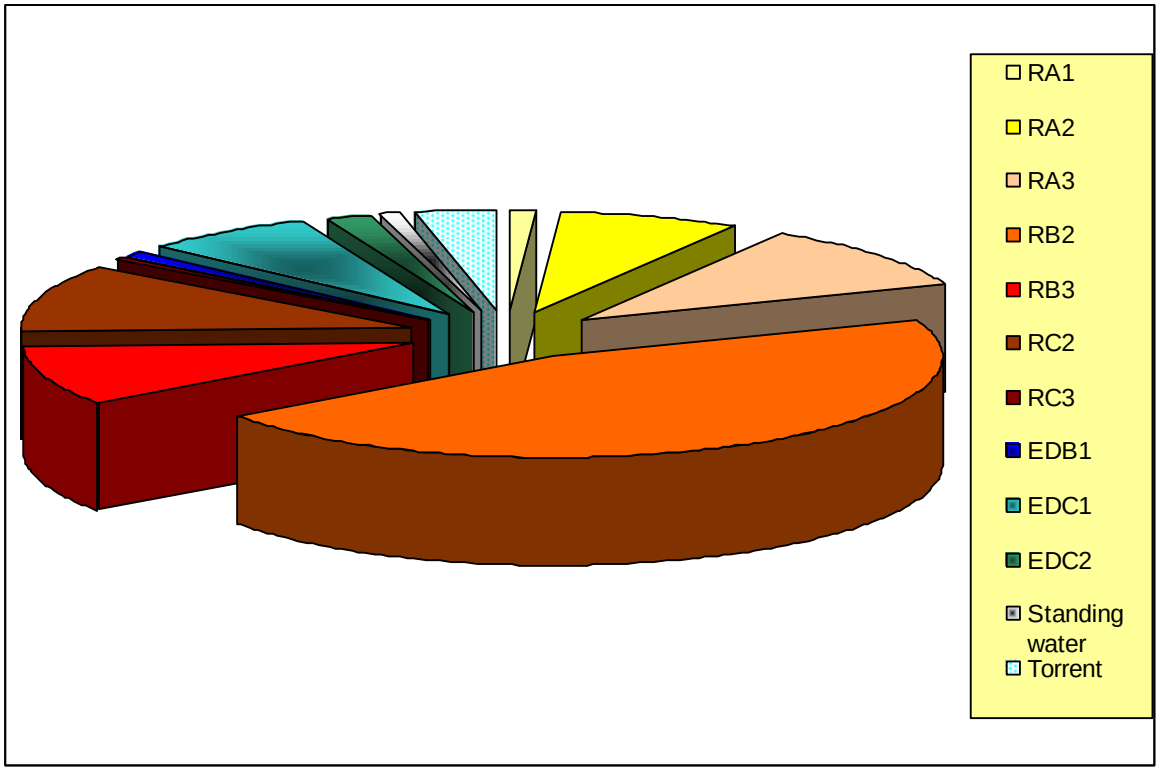

Figure 4. Percentage of habitat types at the survey site at Taverham Mill

4.4 Fish Egg Sampling Results

A total of 50 eggs were sampled from the 4 sites selected during the May walkover survey. Site 4 was devoid of eggs, whereas eggs were abundant at Site 2. The eggs found were all very similar in appearance, although there was some slight size variation from site to site. Generally the eggs sampled were approximately 1mm in diameter and pale yellow in colour at all sites (Fig. 5).

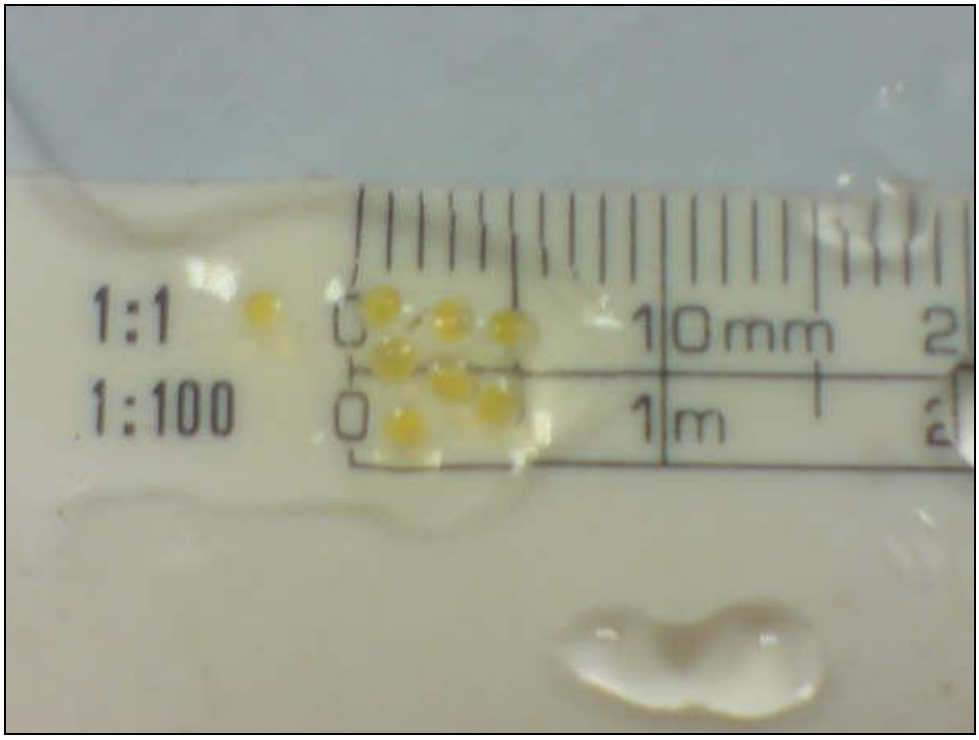

Figure 5. Fish eggs sampled from Site 2 downstream of Taverham Mill.

The survival rate of the eggs in the laboratory was variable with the highest survival rate at Site 2 where 93 % of eggs hatched successfully. In contrast only 40 % of the eggs retrieved from Site 3 gave rise to live young (Table 3). All 39 hatchlings were identified to species and were found to be a mix of chub and minnow.

Table 3. Results of fish egg incubation investigation

Site	Eggs captured	Eggs hatched	% Hatched	Species
1	10	7	70	minnow
2	30	28	93	10 chub, 18 minnow
3	10	4	40	chub
4	No catch	-	-	-

During the July survey, eggs and larvae were found to be abundant within gravel habitats throughout the Taverham site. Subsequent examination of samples in the lab confirmed that these samples consisted of minnow and chub ranging in development from egg to 8.5 am 11 mm respectively.

5.0 DISCUSSION

The dominant habitat type (RB2) recorded during the survey at Taverham Mill is ideal for a variety of rheophylic/lithophilic coarse fish species, particularly when found in conjunction with clean gravels and well oxygenated water. Although behaviour consistent with spawning activity of other species, notably chub, was recorded during the walkover survey in May (see footage on GIS), no barbel were seen during the walkover. As such, it is thought that the small excavations highlighted as redds on the survey output are likely to have been created by chub. This is consistent with the collection of chub eggs from two of the three sites where eggs were recorded.

It is considered that under appropriate flow conditions, the River Wensum at Taverham Mill does provide suitable spawning habitat for barbel. This is supported by anecdotal evidence that barbel have spawned in the reach in previous years. Water temperature was at a level sufficient to encourage barbel to spawn (15^{o} C) on the day of arrival at Taverham (15th May 2008). However, overnight conditions lead to a significant reduction in water temperature and by the morning of the 16th water temperature had fallen to just 11.5^{o}C. It is thought that gravid barbel could have been deterred from moving into the reach to spawn by this sudden fall in water temperature.

Accordingly, the July survey was conducted to detect the presence of early barbel larvae or the eggs from recently spawned fish. The abundance of minnow and chub eggs observed during this survey indeed confirms the suitability of these habitats for lithophilic species. Furthermore, the collection of eggs and larvae of comparable sizes of minnow and chub in both May and July, highlight the extended spawning period of these species.

Based on the results of the two surveys and the lack of barbel sightings by (Anglian Water) site based staff, it would seem likely that environmental conditions during the spring and early summer of 2008 may have compromised the spawning success of barbel in the Wensum. Indeed sub optimum temperatures in particular may have resulted in limited abundance and distribution across the catchment of 0+ recruits.

6.0 REFERENCES

Clough, S., Dennis, P. and Martyn, D. (2007). A technique for mapping fish habitats in lowland rivers. APEM Report.

Environment Agency (2007). Assessing the natural recruitment and sustainability of barbel Barbus barbus (L.) populations in the River Wensum, Norfolk. Environment Agency Internal Report. 39 pp.

Hendry, K. & Cragg-Hine, D. (1997). *Restoration of Riverine Salmon Habitats; A Guidance Manual*. Fisheries Technical Manual 4, R & D: Technical Report W144, Environment Agency, Bristol.

APPENDIX I – CD of GIS Outputs

Instructions

- All habitat types will be automatically selected as themes upon opening the ArcMap file. To view habitats individually deselect any unwanted themes by clicking the appropriate arrow to the off position.

- Images captured during the walkover survey of the study area are hyperlinked to corresponding points along each of the river reaches. To view the images simply click on the dot in the yellow square.