A Modified Method for Appraising the Suitability of Urban Sites in Great Britain, for use by the Eurasian (European) Beaver (*Castor fiber*)

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Foreword

Since the following method was tested, work carried out on population monitoring in the Czech Republic tantalisingly suggests that potential beaver modification of urban fringe areas , induced partly by an expanding population, could infact accommodate 'long term settlement' by beavers in such sections as discussed below. Indeed, the beavers ability to reside in modern agricultural landscapes, which it could be argued are much more 'resource poor' than Medieval agricultural landscapes, possibly throws doubt on how negative habitat loss was on the now extinct United Kingdom (UK) beaver population.

As yet no open release of beaver has been undertaken in the UK, but the lobbying continues.

Abstract

The method presented is a modification of that developed by Pachinger and Hulik (1999), and uses the three-point scoring system that has been adopted by other researchers (e.g. South *et al*., 2001 and Kostkan, 2000). It is intended to be simple and easy to use in the field. Our modification was applied to the River Rother in the urban fringe areas between the industrial conurbations of Sheffield and Rotherham, South Yorkshire. A sample of the results is discussed and the method criticised. Our application of such a method to the urban environment of the River Rother suggests that, although it is a disturbed habitat, the GB urban environment could provide the combination and quality of a range of factors needed to accommodate the catholic behaviour of dispersing beaver. However, it is accepted that there are likely to be many idiosyncrasies that will influence the suitability of an area for dispersing beavers. The inclusion of urban site appraisal to the assessment of the British environment will lead to an increase in the accuracy of population-modelling predictions, following beaver reintroduction to mainland Great Britain.

Key words: *Castor fiber*, field method, prediction, urban sites.

Introduction

The reintroduction of a locally extinct species is encouraged in European Union legislation (Macdonald *et al*., 1997), since the ratification of the *Convention of Biological Diversity* (UNCED Earth Summit '92), through the Biodiversity Action Plans (BAP). Although the Eurasian (or European) Beaver (*Castor fiber*) is not a UK BAP species, it is part of the Species Recovery Programme (SRP), which develops opportunities to expand the ranges of locally extinct animals and plants (EN, 2002a [online]).

Since the 1950s, the Eurasian Beaver has been successfully reintroduced into parts of ten European countries (Macdonald *et al*., 1995, cited in Rushton *et al*., 2000). It has been suggested that *Castor fiber* is a desirable candidate for free reintroduction to mainland Great Britain (Macdonald *et al*., 1995), or at least as a management tool, confined to specific sites (McAllister, 2001). The benefit of beaver reintroduction is in its influence in managing riparian woodland and halting succession of fenland to woodland. As fen is a BAP habitat (EN, 2002b [online]), reintroduction of beaver may be justified by the European Habitats Directive 92/43/EEC, which asks for the provision to be made for "...measures governing the reintroduction of certain native species..." (ECNC, 2002 [online]).

Currently, introductions of *Castor fiber* are planned in Kent, by the Kent Wildlife Trust (McAllister, 2001), in Argyll and Bute, by Scottish Natural Heritage (SNH, 1998) and potentially in Norfolk (South *et al*., 2001). Obviously, reintroduction of a species that has been absent from the ecological and human-managed environment is not necessarily straightforward. The last records of beavers in Great Britain come from Wales (twelfth century) and Scotland (sixteenth century) and their extinction has been partly attributed to habitat loss (Macdonald *et al*., 1995 and Kitchener and Conroy, 1996, both cited in South *et al*., 2001). Therefore, in the context of Great Britain, the major concern is whether there are still adequate habitats capable of supporting viable populations of healthy beavers and whether such populations will cause acceptable or unacceptable interference with existing land-uses. Therefore, before reintroduction is planned, suitable release-sites must be identified. In the densely populated and highly modified island of mainland Great Britain the situation is not directly comparable to the places in continental Europe where beaver populations have been already successfully re-established. Thus, the site-selection methods developed for those European landscapes must be modified for the British environment, yet remain comparable as far as possible.

The key habitat parameters chosen by Scottish Natural Heritage (SNH), for assessing site suitability for beavers were collated. This followed a personal communication with M. Balodis in Latvia (Macdonald *et al*., 1997). Several rural areas were appraised for their suitability for colonisation by beavers. However, the landscape of Great Britain is more intensively used and modified by human activity than the northern, central and eastern European countries where most long-term research has been carried out.

Since there are no wild beaver populations in Great Britain, estimates of future dispersal and colonisation are, of necessity, based on untested assumptions drawn from research carried out in other landscapes abroad. The existing body of research largely concentrates on optimal habitat with little done on more disturbed habitat types. South *et al*. (2001) have considered the potential issue of beaver dispersal through a UK urban environment, concluding that a large human population may hinder beaver dispersal.

Monitoring in the Czech Republic (Kostkan, in print) has shown that the expanding beaver population is colonising the various riparian areas, preferring the forest areas (that which Nolet (1997) describes as prime habitat). There are also signs of grazing and feeding (Figures 1, 2 and 3) in and around the more disturbed environments of intensive agricultural plains and urban areas. This shows that beavers have a surprising ability to migrate through environments that are quite unsuitable for colonisation. Thus, (as Macdonald *et al*.,1997, tacitly suggest) the consideration of suitable routes for beaver dispersal is probably as important as the identification of optimal sites for release and colonisation. Hitherto, urban areas have not been seriously considered in the studies carried out in Great Britain. Whilst South *et al*. (2001) have expressed concern over the suitability of the urban environment, Webb *et al*. (1997) report that SNH and the Institute of Terrestrial Ecology agreed to disregard the urban/industrial areas as suitable beaver habitat. Indeed, there appears to be only one study of a habitat classification system for field-use in typical urban environments on mainland Europe (Pachinger and Hulik, 1999). Particularly in Great Britain, the propinquity of urban areas and suitable beaver sites is an issue worth studying. This is seen as an opportunity to suggest a method that has been adapted for use in this country.

Figure 1. Beaver Activity. Beaver territorial marking caused by grazing bark from a large tree. The resulting bare wood scar, called a 'mirror' (Kostkan, unpublished) is refreshed by regrazing whenever the wood dulls. This is therefore a good indicator of frequency of beaver presence.

Photo: S. Baker.

Figure 2. Sign of Beaver Activity. Beaver feeding station on the River Morava, Czech Republic.

Photo: S. Baker.

Figure 3. Beaver activity unchanged by highway. Beaver foraging activity on the River Morava, near the floodplain. (Czech Republic).

Photo: V. Kostkan.

Definitions

Especially where there is subjectivity, terms must be defined within certain limits.

General Terms

Suitable dispersal habitat

Successful beaver dispersal requires the availability of habitats that are suitable for occupation (Macdonald, 1997). In defining what is considered 'suitable', Pachinger and Hulik's (*ibid*.) description of sites "only occupied once, and for a short time", were considered as a minimum point of reference for occupation and as a standard point of reference for dispersal routes. Such sites would score an average of nine using their assessment method, so nine is also the threshold value used in our assessment.

Urban environment

For our purposes, this was defined as areas covering the truly urban (city and town centres and densely built-up areas) and the suburban (inhabited areas near countryside, or with large gardens, municipal parks or recreational areas).

Methodology

A method suitable for use in urban environments is described here for a predictive assessment. It is a modification of the method used by Pachinger and Hulik (*ibid*.), who claim:

"[We have] developed a beaver habitat classification system for use in an urban area [and that] with slight modification for local conditions, [it] can be used... to predict which currently unoccupied areas may be suitable for beavers in the future." (Pachinger and Hulik, 1999, p.60).

Pachinger and Hulik's (*ibid*.) habitat classification system was developed from observations of occupied and resettled beaver sites in the greater Bratislava area of Slovakia. From these data they built a schema to analyse habitat suitability of an urban habitat. The schema involves assessments of the following criteria.

Environmental criteria:

- Food abundance
- Depth of water
- Bank profile
- Frequency of disturbance by direct human visits

- Distance to footpath or walkway (sidewalk)
- Distance to a busy road
- Behavioural criteria
- Length of period of occupation
- Number of times the site was resettled after initial occupation

A three-point scoring system is used for each factor: one point for the lowest quality; two for intermediate quality; three points for optimal quality (see Figure 4). Pachinger and Hulik (*ibid*., p.54) claim that this "avoids any complications caused by subjective evaluation methods." However, due to the beaver's crepuscular behaviour and 'plastic' nature (Nolet, 1997, p.11), their resource requirements are not fully understood (nor, perhaps, perfectly predictable - see Figure 3) and any attempt to classify the quality of their habitat should perhaps be considered subjective.

According to this method, any habitat scoring a minimum of nine is regarded as a suitable dispersal route for beaver.

Method

Our modified method was used to test its ease of application in the field. The test area was along the River Rother in the urban fringe areas between the industrial conurbations of Sheffield and Rotherham, South Yorkshire (Figure 5). The scoring system is based on Pachinger and Hulik's (1999) habitat assessment system and there are elements of Macdonald's *et al*. (1997) approach to field survey.

Figure 4. Pachinger and Hulik's (1999) Three-point Habitat Scoring System. (Based on Pachinger and Hulik, 1999, p. 55)

	1 point	**2 points**	**3 points**
Food abundance	Low	Moderate	High
Depth of water	0.5 - 1.5 m	> 3 m	1.5 - 3 m
Bank profile	Shallow bank with a slope of < 40°	High bank with a slope of 40 - 60°	High bank with a slope of 60 - 80°
Frequency of disturbance by direct human visits	Daily, many times	Once every 2 - 3 days	Less than once per week
Distance to walkway	1 - 20 m	20 - 80 m	> 80 m
Distance to busy road	10 - 40 m	40 - 200 m	> 200 m
Length of period of occupation	1 - 3 months	3 - 18 months	> 19 months
Number of times the site was resettled after initial occupation	Once	Twice	Three times

Figure 5. Location of the River Rother Study Area.

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Phase 1: Map and Aerial Photography Habitat Analysis

The preliminary survey involved the use of CR viewer aerial photographs (courtesy of Rotherham MBC) and OS map SK 48 at a scale of 1:25,000, to identify homogenous sections of the River Rother for habitat assessment in the field. These tools were also used to identify surrounding habitats and conditions that could not be recorded in the field (e.g. due to restricted views or access, and health and safety issues). The study area was divided into sample sections, so that each section of the river (with its immediate environment) was distinct from the next, due to some major or overriding factor or combination of factors, which would influence beaver dispersal. Yet each section would be generally homogenous within itself. South *et al*. (2001) acknowledge previous studies on beavers in the Netherlands and Germany that have shown that beavers require the presence of deciduous woodland close to water (primarily as a food source). Pachinger and Hulik (1999, p.60) consider that "large-scale human activities" have a significant negative impact on beaver occupation and dispersal, due primarily to disturbance. Therefore, surrounding areas of woodland and large-scale human activity were considered to be the most dominant factors and, as such, they provided the basis for defining sections within the study area. The sample sections are shown in Figures 6a and 6b. For each section, a field record sheet was completed, recording the score for each of the criteria in Figure 7.

Phase 2: Field Habitat Assessment

As the beaver is absent at our sites, there can be no score for the two behavioural criteria of Pachinger and Hulik's list ('*length of period of occupation*' and '*number of times the site was resettled after initial occupation*'). Therefore these two criteria are replaced by other criteria shown by field-observation to be important factors in site selection by beavers (Kostkan, 2002; Pachinger and Hulik, 1999), namely '*distance to busy road*' and '*bank characteristics*'.

In urban environments presenting a range of recreational, industrial, infrastructural and derelict sites, the number of direct human visits is difficult to record quickly, with any long-term accuracy. Thus, the original environmental criterion '*frequency of disturbance by direct human visits*' was replaced by '*water use*', to accommodate direct disturbance by human recreational use (e.g. boating), infrastructure (e.g. concrete canalisation) and industrial use (e.g. water abstraction or contaminated water discharge). In this way, the schema was made more relevant to the urban environment by concentrating on factors that are logically assumed to become more influential on beaver behaviour whilst in the urban environment. Yet the modified schema is still quite comparable with the original schema as five out of eight criteria are the same. The modified schema, with scoring parameters, is shown in Figure 7.

Site Scoring Criteria Defined

Below, the individual scoring criteria are individually explained and some are illustrated in Figure 8.

Food abundance

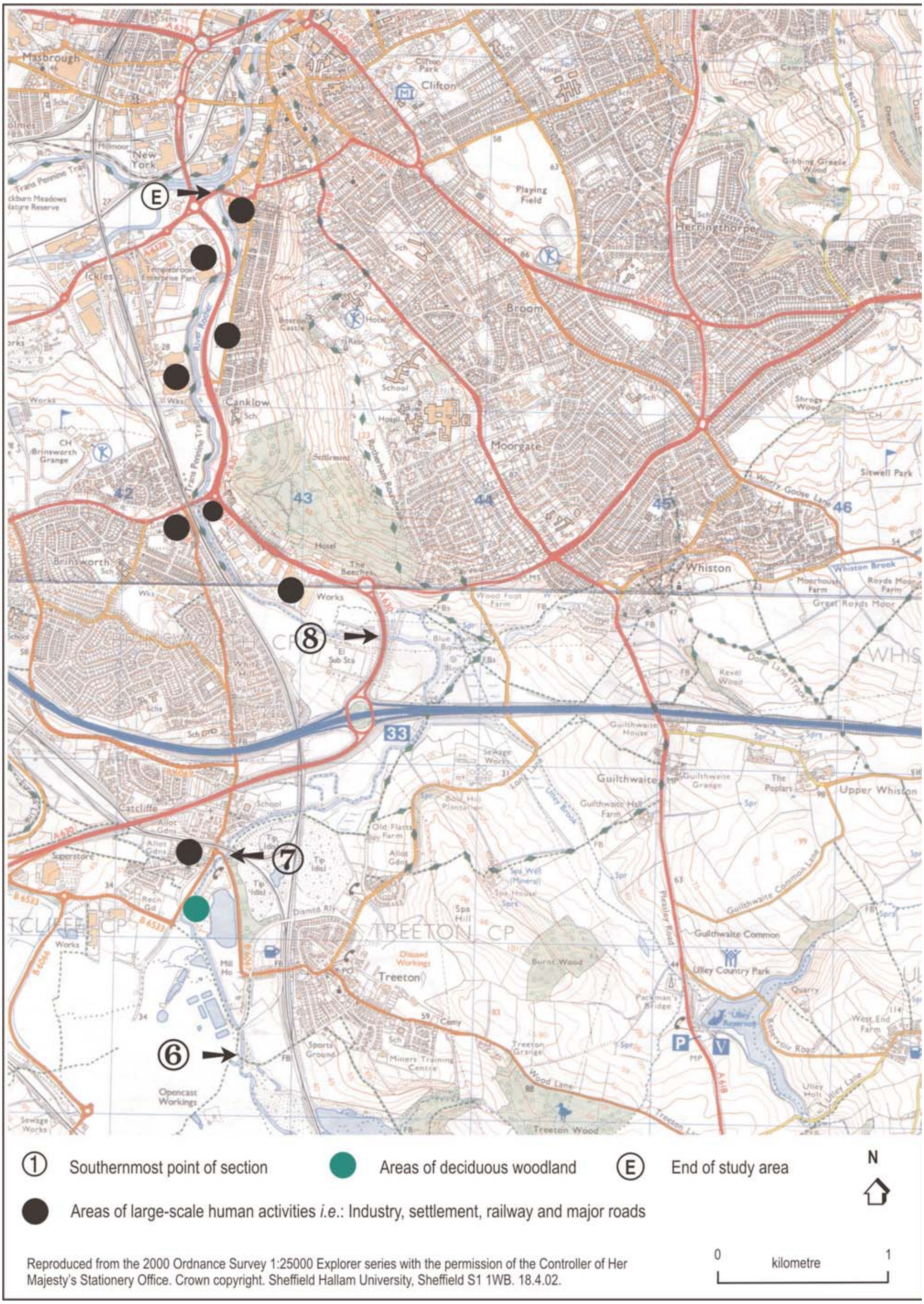
Both the quality and quantity of aquatic plants and the riparian zone vegetation preferred by beavers were considered. During spring, summer and autumn, beavers feed primarily on aquatic and herbaceous vegetation, whilst in winter, the leaves, bark and wood of trees and shrubs become the staples.

Depth of water

Water depth is important to beavers. Deeper water provides a means of escape from danger, whilst shallower water encourages the growth of aquatic vegetation. A depth of two metres is

Figure 6a. Southern half of the River Rother Study Area. The numbers represent the southern-most part of each distinct sample area.

Figure 6b. Northern half of the River Rother Study Area. The numbers represent the southern-most part of each distinct sample area.



regarded as most favoured for colonisation, although shallower water is acceptable for foraging and dispersal.

Bank profile

Beavers require deep and steep enough banks to enable them to dig secure burrows for protection and shelter. The entrance to the burrow is under the surface of the water, but the burrow void is above the water. Banks of at least one metre freeboard with a slope of up to 80 degrees from the horizontal appear to be most favoured.

Bank characteristics

Beavers prefer physically stable earth banks and those protected from disturbance by dense vegetation. Although beavers are not able to dig through steel or concrete, banks that are reinforced by stones (rip-rap) are sometimes excavated and inhabited (Kostkan, 2002).

Surrounding Habitats

These can provide beavers with additional food sources. Individuals may forage up to 200 metres from the water's edge, although only if the conditions are suitable, as beavers generally do not like to venture too far from the safety of water (Kostkan, unpublished).

Distance to walkway

This influences the likelihood of human disturbance that can influence beaver behaviour.

Distance to busy road

As well as influencing behaviour, direct road-kills, and pollution from exhausts and road run-off may affect the population.

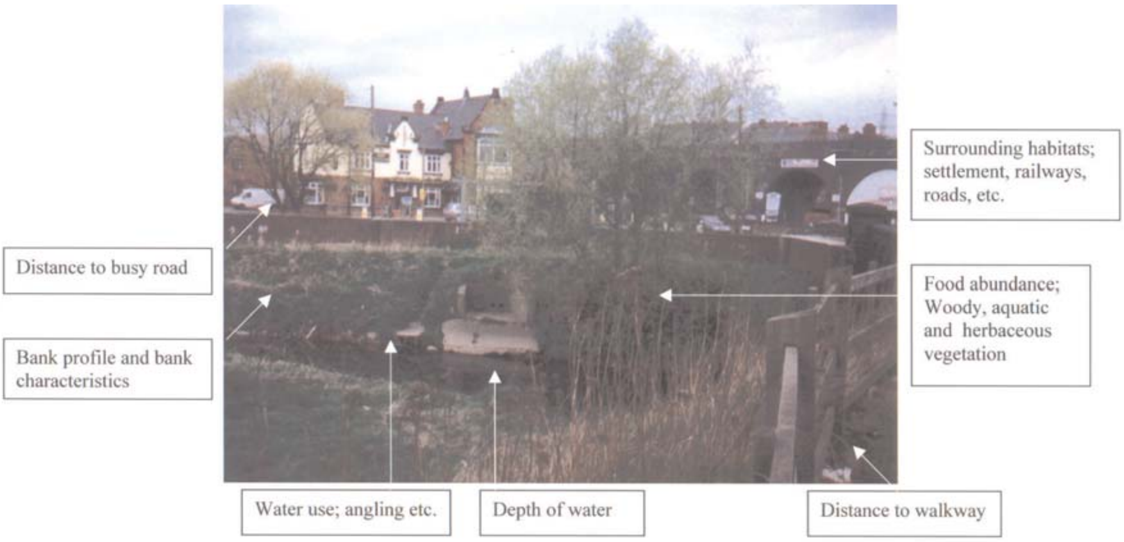
Water use

Power boating is considered very disturbing for beavers, whereas management of the habitat as a nature reserve is considered beneficial (Kostkan, 2002).

Figure 7. The Predictive Habitat Scoring System for use in Uncolonised Urban Areas.

	1 point	**2 points**	**3 points**
Food abundance	Low	Moderate	High
Depth of water	0.5 - 1.5 m	> 3 m	1.5 - 3 m
Bank profile	Shallow bank with a slope of < 40°	High bank with a slope of 40 - 60°	High bank with a slope of 60 - 80°
Bank characteristics	Artificial (steel, concrete or similar)	Modified/semi-natural, stable banks with little or no vegetation	Modified/semi-natural, stable banks with medium to high vegetation cover
Surrounding habitats (10 - 50m from water)	Industry, settlement, railway	Roads, meadows, arable	Woodland, scrub, water bodies
Distance to walkway	1 - 20 m	20 - 80 m	> 80 m
Distance to busy road	10 - 40 m	40 - 200 m	> 200 m
Water use	Abstraction, powered boating	Angling, row-boating	Nature reserve, none

Figure 8. Habitat Factors assessed in the field. This photograph shows a typical suburban setting on the River Rother, between Sheffield and Rotherham, South Yorkshire, UK.
Photo: S. Baker.



Urban sites with a score as high as the 'suitable dispersal habitats' (defined above) in the Slovakian study, equating to a minimum rating of nine, may be regarded as suitable for dispersion.

Results

The results of the criteria scoring are summarised in Figure 9. More detailed results, including site descriptions, are given for the highest- and lowest-scoring sites as well as for an intermediate site.

Highest-scoring Site

River section 6 (Catcliffe Flash) emerged as potentially the most favourable section for accommodating dispersing beaver. It was gratifying that this was also the section that gave the best general visual impression of beaver suitability in the field. It is a wetland nature reserve, containing high food (herb) abundance, and wet woodland. It is immediately adjacent to the River Rother, with both optimal water depth and bank profile (Figure 10).

Figure 9. Summary of Results of the modified assessment method at the sites on the River Rother.

River section	Local name	GPS position (S-most point)	Length of section (km)	Suitability score
1	Rother Valley Country Park	SK45058153	2.8	16
2	Beighton	SK44768376	1.3	11
3	Woodhouse Washlands	SK43998480	1.1	16
4	Woodhouse sewage works	SK43228570	0.5	16
5	Orgreave open-cast coal field	SK43248616	1.5	15
6	Catcliffe Flash	SK42708748	1.3	19
7	M1 motorway	SK42618846	2.2	18
8	Brinsworth and Canklow	SK43528972	3.3	16
all			(total) 14	(average)16

Figure 10. The Scores for Assessment Criteria for Catcliffe Flash.

Section	Food abundance	Depth of water	Bank profile	Bank characteristics	Surrounding habitats	Dist. to walkway	Dist. to busy road	Water use
6	3	3	3	2	3	1	1	3

Hydrological factors:

This section contains an outfall from the opencast workings. It has a mean depth of over 1.5m, but this does fluctuate. Flooding to the east of the river is also likely to occur as part of a rarely used strategic flood defence system (unused in the last 10 years). Within 10 to 50m east of the riverbank is a wetland nature reserve. On the west side are several open water bodies.

Vegetation and banks:

To the south of the section, the riverbank is covered with trees (primarily willow) stretching up to 5m from the water. There is suitable herbaceous bank vegetation, but no channel vegetation is obvious. In the north of the section, the riverbank supports little in the way of trees, shrubs or suitable herbaceous vegetation and no channel vegetation is obvious. No surrounding vegetation is present to the west, due to open-cast workings, but in the east, within 10 to 50m of the river, the wetland nature reserve supports a wet wood area surrounded by a small, but dense birch/willow area. The banks have been modified, but may be considered semi-natural and stable with a 60 - 80° slope.

Anthropogenic factors:

The west bank receives high visitor pressure from anglers and walkers. There is no fishing allowed on the east bank or on the nature reserve, and there is no public access to the southern end of the east bank, where human disturbance levels are low.

Intermediate-scoring Site

River Section 4 (Woodhouse Sewage Works) scores the same as the average for the whole study area (Figure 11).

Hydrological factors:

This section contains a sewage works outfall and has a mean depth of over 1.5m. However, being part of a strategic flood-defence system, the site is liable to deliberate flooding (although this has not happened in the last 10 years).

Vegetation and banks:

The riverbank is covered with a variety of trees and shrubs (including birch, willow, alder, poplar, cherry, hawthorn and blackthorn) spreading up to 10m from the water. The surrounding vegetation is amenity grassland. The banks have been modified, but may be considered semi-natural and stable with a 40 - 60° slope.

Anthropogenic factors:

There is no public access and little disturbance to the east of the river, due to the presence of the sewage works. The west side of the site receives extensive public access and displays evidence of misuse by fire and fly-tipping.

Figure 11. The Scores for Assessment Criteria for Woodhouse Sewage Works.

Section	Food abundance	Depth of water	Bank profile	Bank characteristics	Surrounding habitats	Dist. to walkway	Dist. to busy road	Water use
4	2	3	2	3	1	1	2	2

Lowest-scoring Site

River Section 2 (Beighton) scores low for a combination of a range of factors, including food abundance, depth of water and disturbance (Figure 12).

Hydrological factors:

This section of river contains a weir, floodgate and outfall from a rail depot. There is a mean depth of 0.75m. However, being part of a strategic flood-defence system, the site is liable to deliberate flooding (although this has not happened in the last 10 years). A small water body is located at the southern end of the section.

Vegetation and banks:

There is little suitable obvious herbaceous vegetation, shrubs or channel vegetation. In the south of the section, the riverbank supports little in the way of trees, and surrounding vegetation is primarily that of rough pasture with the occasional willow. A small carr has formed around the water body. In the north of the section, the riverbank is covered with trees (primarily birch and willow) for a distance of up to 10 m from the water. The surrounding vegetation is that of rough pasture with occasional wet rush pasture. The banks have been modified, but may be classed as semi-natural. They are stable, with a 40 - 60° slope.

Anthropogenic factors:

Disturbance is high due to close rail, road, industry, housing and recreation. There is no public access in the north, but the south of the section shows evidence of misuse by fire and fly-tipping.

These results are, to some extent, corroborated by comparison with only the applicable criteria from Pachinger and Hulik's schema (i.e. removing those criteria added in our method and using only the five mutual criteria). See Figure 13.

It is interesting to note section 8 (that runs through the industrial area of Brinsworth and Canklow). It has the highest score for large-scale human activity. This includes extensive road embankments and small factory units. The area is separated from residential areas by the large road on one side, and the railway on the other. However, this section also scores high for herbaceous vegetation, due to the ruderal nature of the environment.

Figure 12. The Scores for Assessment Criteria for Beighton.

Section	Food abundance	Depth of water	Bank profile	Bank characteristics	Surrounding habitats	Dist. to walkway	Dist. to busy road	Water use
2	1	1	2	2	1	1	1	2

Figure 13. Scores for the River Rother sample sites, using only the five assessment criteria from Pachinger and Hulik's (1999) method, which were used in the modified method.

Site section	Local Name	Score
1	Rother Valley Country Park	9
2	Beighton	6
3	Woodhouse Washlands	9
4	Woodhouse sewage works	10
5	Orgreave open-cast coal field	9
6	Catcliffe Flash	11
7	M1 motorway	10
8	Brinsworth and Canklow	9
all		(average) 9

Discussion

The proposed method was carried out in the industrial midlands of England, in the environment of Britain's fifth largest city. According to this method, the section of the River Rother that flows between the almost continuous conurbations of Sheffield and Rotherham, is generally suitable for dispersing beaver.

Section 6 (Catcliffe Flash) is the most suitable part of the sample site, as its situation renders the whole reserve much like an isolated island habitat. Particularly on water bodies, islands are very positive factors for beaver, due to the isolation from direct disturbance. Beavers were released at Chomoutov Sand Mine (Czech Republic) in 1992 (Kostkan, 1995) and still occupy the area (Kostkan, 2002). The rehabilitated Chomoutov Sand Mine consists of a lake with wet woodland and island habitats. These islands apparently make up for the impact of footpaths and shore-side angling around the lake. Although there are no water-bound islands at Catcliffe Flash, the physical barriers to direct human interference will mitigate against the potential effects of human activity in the surrounding area. It is suggested that, together with the potential for foraging along the rest of the River Rother sample site, there may even be potential for Catcliffe Flash to provide a lodging site. Assessment for occupation, however, goes beyond this method, alone.

Section 2 (Beighton) scored the lowest, across a range of factors, including food abundance, depth of water and disturbance. It was the only section to score lower than the threshold of suitability for beaver dispersal. As the river section through Beighton is 1.5km long, it leaves 12.5km (90.7%) of the study area with the potential to accommodate dispersing or foraging beaver. It could be argued that in a 14km length of river, 1.5km of unsuitable, but traversable habitat would not present a barrier to a mobile species such as the beaver. It is important to note that no large-scale water management features, such as dams or insurmountable weirs, are present here. Such features are present within urban environments in Great Britain, and as shown in previous studies (Pachinger and Hulik, 1999; Kostkan, 2002), they can constitute significant barriers to dispersing beavers. It is worth considering whether such features should score even lower on the '*water use*' criterion.

The result from Section 8 raises an interesting point to consider. Low levels of, or non-disturbance is known to be a critical factor in long-term settlement by beaver. However, disturbance may not always be as effective on dispersal of beavers as it may be on long-term settlement. Indeed, anthropogenic influences within an urban environment may be beneficial in supporting dispersing or distant-foraging beavers. Nolet (1994) suggests that urban wastewater, which adds nutrients and increases plant growth, may be beneficial. There is often an increased growing season in urban areas due to the aerial heat island and warm-water discharges.

Another point raised by results from Section 8 is that of disturbance resulting from recreation. Part of the long-distance Trans Pennine Trail runs through this section. It is a walking and cycle path which is included as part of the regeneration plan for the area. This is not yet a busy path and currently mostly used by a few dog-walkers (generally morning and early evening). It is very unlikely that many people will use this path in darkness. Thus, the type and level of disturbance is very different from a site that may be used by groups of children playing near their homes, or picnickers or ramblers. Bearing in mind the crepuscular nature of the beaver, the period and time of disturbance (both diurnal and annual) are probably almost as important as the type of disturbance the method should consider this.

Critical analysis of the method design reveals sources of possible inaccuracies in the habitat assessment. The quality of information may have had some impact on the accuracy of scoring due to:

- Lack of information regarding water abstraction levels
- Lack of information regarding strategic flooding policies
- Time of year
- State of vegetation

Another idiosyncrasy of beavers is when and where they will choose to build dams with lodges, rather than burrowed bank dens. Where there are suitable sites on large, wide rivers, beavers will choose to build dens out of preference. However, where there is a shortage of such sites, beavers may dam small, shallow streams in order to raise the water level. There, they may build dens or lodges. The choice also depends on building materials, river profile and water velocity. Particularly in the sub-urban environment, this behaviour is unlikely to be predictable, thus the water depth criterion '0-1.5 metres' may be too broad or simplistic for such situations.

An additional and absolute criterion to be added is that of bank material. If the riverbanks are reinforced with concrete or steel, then there is no chance of bank activity. Usually such banks are vertical, which will also make emergence from the water impossible and prevent grazing in that area.

The data obtained from Pachinger and Hulik's (1999) research relates to occupation of a reintroduced population. Whilst in this case such data is probably more appropriate than life-history information derived from long-established populations, it must be remembered that no two populations are likely always to behave in the same way. Both Macdonald *et al*. (1997) and South *et al*. (2001) have highlighted this, stating that unfamiliar surroundings and social behaviour strongly affect beaver dispersal.

Conclusion

This research was an attempt to produce a method suitable for a largely ignored set of habitats (those of the urban environment). We feel that it works as a first stage to the inclusion of these habitats in the pre-release modelling currently undertaken in the UK. As South *et al*. (2001) noted, modelling predictions are enhanced by predictive fieldwork. If we accept the premise on which our method is based, then the greatest personal lesson from this exercise was the confirmation that a variety of combinations of a wide range of factors may all still accommodate dispersing beavers.

The adaptable, catholic behaviour of the beaver will vary according to the resource availability. Thus, the suggested method may be too specific in its scoring of assessment criteria and too limited in its range of criteria. However, it may give a reasonable, perhaps reliable, estimate (in all but the most extreme environments) after quick and simple desk survey and fieldwork. Whether the method is too specific or too positive in its scoring will not be known until beaver are back in the River Rother and perhaps exploring the culverts and rivers within the city of Sheffield and the town of Rotherham.

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