using science to create a better place

Assessment of the distribution of *Bembidion Testaceum* and reasons for its decline

Science Report: SC030199/SR

SCHO0905BJOA-E-P

The Environment Agency is the leading public body protecting and improving the environment in England and Wales.

It's our job to make sure that air, land and water are looked after by everyone in today's society, so that tomorrow's generations inherit a cleaner, healthier world.

Our work includes tackling flooding and pollution incidents, reducing industry's impacts on the environment, cleaning up rivers, coastal waters and contaminated land, and improving wildlife habitats.

This report is the result of research commissioned and funded by the Environment Agency's Science Programme.

Published by:
Environment Agency, Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol, BS32 4UD
Tel: 01454 624400 Fax: 01454 624409
www.environment-agency.gov.uk

ISBN: 1 84432 490 7

This report is printed on Cyclus Print, a 100% recycled stock, which is 100% post consumer waste and is totally chlorine free. Water used is treated and in most cases returned to source in better condition than removed.

Further copies of this report are available from:
The Environment Agency's National Customer Contact Centre by emailing enquiries@environment-agency.gov.uk or by telephoning 08708 506506.

Author(s):
J.P.Sadler, D.Bell & P.M.Hammond

Dissemination Status:
Publicly available

Keywords:
Bembidion testaceum, shingle beetle, rivers, populations, distribution, decline of, UK,

Research Contractor:
School of Geography, Earth & Environmental Sciences
University of Birmingham,
Edgbaston
Birmingham
B15 2TT

Tel: 0121 414 5543
Web: www.ges.bham.ac.uk

Environment Agency's Project Manager:
Mike Williams, Exeter Office

Science Project Number:
SC030199

Product Code:
SCHO0905BJOA-E-P

Science at the Environment Agency

Science underpins the work of the Environment Agency, by providing an up to date understanding of the world about us, and helping us to develop monitoring tools and techniques to manage our environment as efficiently as possible.

The work of the Science Group is a key ingredient in the partnership between research, policy and operations that enables the Agency to protect and restore our environment.

The Environment Agency's Science Group focuses on five main areas of activity:

- **Setting the agenda**: To identify the strategic science needs of the Agency to inform its advisory and regulatory roles.
- **Sponsoring science**: To fund people and projects in response to the needs identified by the agenda setting.
- **Managing science**: To ensure that each project we fund is fit for purpose and that it is executed according to international scientific standards.
- **Carrying out science**: To undertake the research itself, by those best placed to do it - either by in-house Agency scientists, or by contracting it out to universities, research institutes or consultancies.
- **Providing advice**: To ensure that the knowledge, tools and techniques generated by the science programme are taken up by relevant decision-makers, policy makers and operational staff.

Professor Mike Depledge Head of Science

Executive Summary

Bembidion testaceum Duftschmid is one the most enigmatic and poorly researched beetle species associated with exposed riverine sediments (ERS). A detailed review of the distribution and ecology of species was carried out in the summer of 2004. The objectives of the work were fivefold:

1. Review the past status of the species in the UK by examining all existing records of *Bembidion testaceum*.

2. Examine a range of museum collections to validate previous records and search for additional ones.

3. Undertake field surveys of rivers with records of the species to establish its current distribution and examine its autecology and habitat affinities.

4. Establish whether the species has actually undergone a recent reduction in range and if so identify possible reasons why this has occurred.

5. Briefly consider the species distribution in Europe.

The research involved a combination of literature search on the existing knowledge of the species, confirmation of records using museum specimens, field survey of sites where *B. testaceum* has been recorded previously (excluding Scotland) and limited autecological work.

The work has shown that the species has a northerly and westerly distribution in the United Kingdom and although it is listed as Nb (Nationally Scarce) in the conservation literature its present distribution indicates that it is very rare in the UK. The desk study suggested records of the species from 15 UK 10km squares of which 4 were post-1980 records. The fieldwork and the museum work helped both to confirm the species presence on some of its former sites and to uncovered new, previously undocumented specimens and records. Thirty-four new records were uncovered as a result of the museum visits and an additional 17 new records derive from the fieldwork. An analysis of the consolidated list of 74 secure records for the species suggested long term persistence of populations on the Rivers Usk and Monnow in Wales, and the Rivers Teme, South Tyne, Devil's Water and Tyne in England.

Although care must be taken not to read too much into absence data, the species now appears to occupy fewer river catchments than it did in the past. Although old records exist *B. testaceum* has not been found on a number of rivers in SW Scotland (e.g. Nith and Clyde), Cumbria (e.g. Eden, Irthing), Wales (Wye and Taff), the Yorkshire Derwent and rivers in Devon (e.g. the Dart, Teign and Exe), despite a reasonable amount of recent fieldwork. One might, therefore, cautiously accept that some of the absences highlighted in this study are real or, if not, indicate very low population levels. At the very least this work illustrates that the species conservation status warrants redesignation from Nb to RDB2.

At a macro-scale, the species appears to be tied to catchments with hard rock geology that erodes to produce coarse sandy sediments. Within this categorisation, the macrohabitat that the species frequented was found to be quite variable. The records examined during this work when coupled with fieldwork observations illustrate that the species can be found in a range of sedimentary or morphology units on UK rivers, and even anthropogenic habitats such as gravel pits and newly created rivers. However, the species shows strong microhabitat and sedimentary affinities to unconsolidated, unvegetated sediment of varying sizes ranging from pebbles to cobbles overlying coarse and clean sands. It is clear also from fieldwork in areas of former records that the species does not enjoy siltation. The species appears to be deleteriously affected by habitat loss at both the local and catchment scales. The report concludes with recommendations for further work.

Acknowledgements

The authors wish to make principal acknowledgement to the Environment Agency (EA) who funded the survey and in particular Mike Williams who was the project manager. Thanks are due to Mark Telfer for the provision of records from the UK carabid recording scheme, Adrian Fowles for data from the CCW biological records database, and numerous coleopterists and museum curators who have commented on records and allowed their specimens to be examined.

Contents

List of figures

List of tables

1.Introduction

Exposed riverine sediments (ERS) represent important primary habitats within the land-water ecotone of river corridors (Ward *et al.*, 1999). In highly managed landscapes ERS may be seen as providing relatively natural habitats and their size, type and frequency of occurrence gives them high conservation value (Sadler *et al.*, 2004). Three national R & D projects have been funded by the Environment Agency to examine the nature, ecology and management of ERS. The first provided a desk-based review of the nature of the national ERS resource (Eyre & Lott, 1997). The second aimed to create a nationally replicable sampling protocol (Sadler & Petts, 2000) and the third project created 'baseline' ecological criteria for the national assessment of ERS Coleoptera in England and Wales (Sadler & Bell, 2002). These reports, coupled with recent regional Environment Agency projects (e.g. Bell & Sadler, 2003a; Bell *et al.*, 2004) and other research undertaken in Scotland carried out by Eyre and his co-workers (e.g. Eyre, 2000), have clearly shown that ERS are home to a wide range of endangered, rare or nationally scarce species of invertebrates.

As part of the UK Biodiversity Action Plan (BAP) process, the UK Biodiversity Steering Group has created a grouped species action plan for six species of ERS Coleoptera and additional plans exist for two species of Diptera and one species of water beetle (Anon, 1999), all of which are seen as ERS specialist invertebrates. Of the whole group, *Bembidion testaceum* is perhaps the most enigmatic. The species has western and northern distribution in the UK, similar to a range of other ERS specialists, although, unlike many of those, its distribution is much more patchy. An examination of pre-existing records (Luff, 1998), suggests not only that the species once enjoyed a much more widespread distribution in the UK, but that it appears to have undergone a decline during the last few decades. It was listed as known from only four 10km squares in the BAP (Anon, 1999). Furthermore, despite a considerable amount of recent survey effort, it has been found only on three separate occasions since 1998, twice on the River Usk in Wales (Hammond, 2003; Sadler & Bell, 2002) and once from the River Keekle in West Cumbria (Hewitt pers. comm.) in 2000, casting some doubts over its conservation status of Nb (Hyman, 1992).

1.1. Aims and objectives

This project aims to examine the ecology and distribution of *B. testaceum* in the UK.

The specific objectives of the project were fivefold:

1. Review the past status of the species in the UK by examining all existing records of *Bembidion testaceum*.

2. Examine a range of museum collections to validate previous records and search for additional ones.

3. Undertake field surveys of rivers with records of the species to establish its current distribution and examine its autecology and habitat affinities.

4. Establish whether the species has actually undergone a recent reduction in range and if so identify possible reasons why this has occurred.

5. Briefly consider the species distribution in Europe.

2.Programme of work and methodology

2.1 Desk study of known records

An extensive record of ERS species has been created in a Recorder 2002 database as part of an on-going ERS project funded by the Countryside Council for Wales (CCW). The database holds distributional records on *B. testaceum* from the following sources: Invertebrate Site Register (Ball, 1994); CCW records database (until 2003); the carabid recording scheme (Luff 1998); records collated from a thorough review of the UK literature; and records derived from all recent survey work in England, Wales and Scotland (Figure 1). Unfortunately, many of the old records require verification, as specific identification of this species can be difficult. As an essential first step in the project, we aimed to validate records in the current database by:

1. Tracking down and identifying as many previous records as possible if specimens are still available. Major museums and some known collectors were approached. This process was started by Peter Hammond as part of Countryside Council for Wales contract in 2002-3 (Hammond 2003).

2. Contacting Mark Telfer (current Carabid recorder for the UK) to establish whether any new records have been submitted to the carabid recording scheme that we are not aware of.

Records were considered valid if the specimen had been examined either by any of the research team (Jon Sadler, Peter Hammond, David Bell) or by certain known coleopterist authorities (e.g. Dr Martin Luff, Dr Derek Lott). If specimens were not directly verified by viewing, records were accepted if the initial collector was a known authority or if a known authority determined the specimen.

2.2 Field survey of current and former sites

Figure 1 shows the distribution of *B. testaceum* in the UK prior to the onset of this work. It appeared that this species was very localised and recorded from only a few, widely scattered areas. Using these data we selected five survey areas of former and current sites to target our field effort. The survey did not include any Scottish rivers, despite the presence of an old and unconfirmed record in the Invertebrate Site Register of the species on the River Irvine at Irvine.

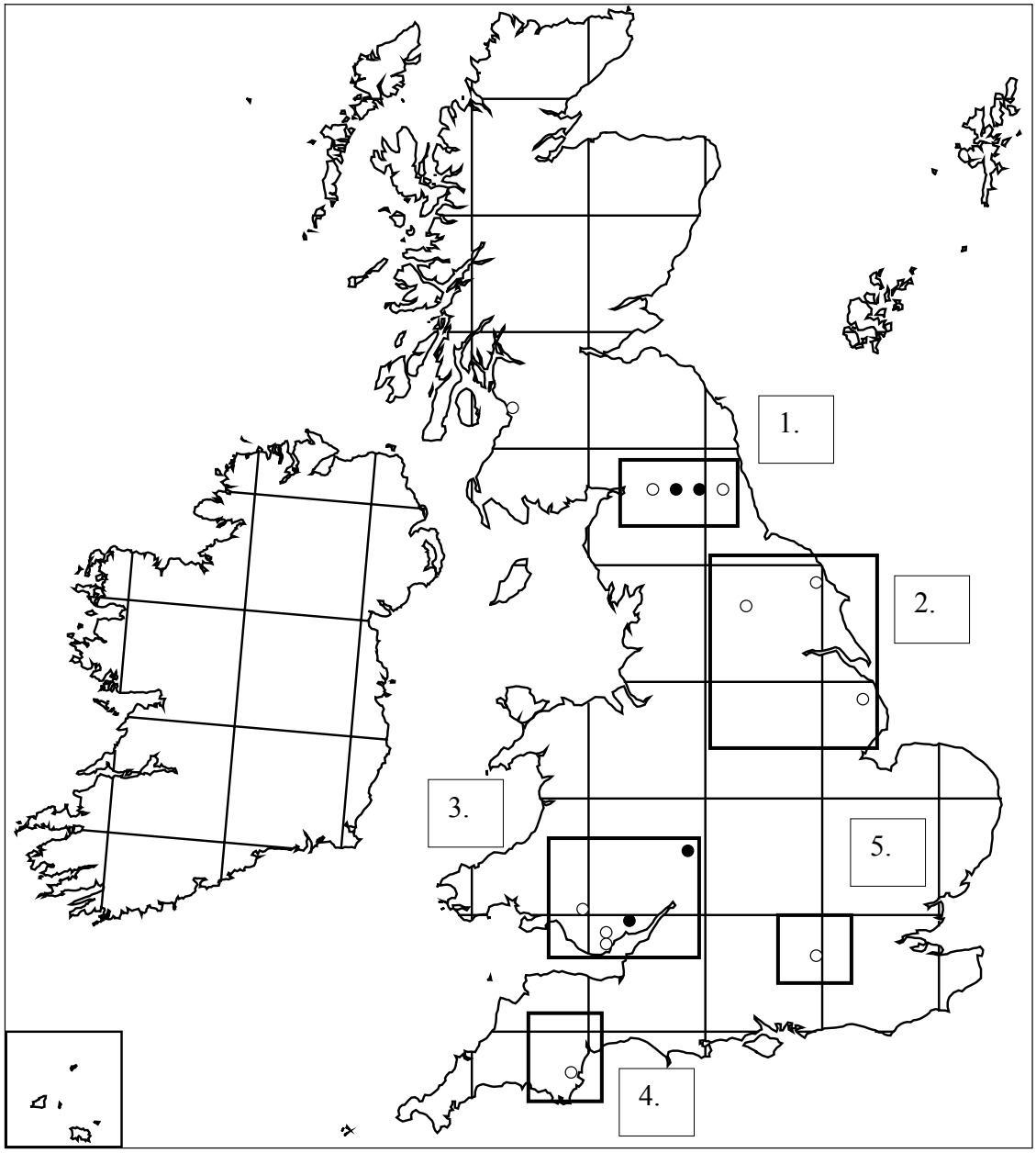

Figure 1: Previous distributional records of Bembidion testaceum and potential survey areas (Data from ERS database – sources CCW, BRC, ISR). Open circles refer to pre 1980 records and filled circles are post-1980 records.

3. Survey methodology

3.1 Biological sampling

Each of the survey areas was visited in turn during the late spring and early summer (between May and July) of 2004. All sites were sampled using direct search techniques in line with the guidelines in Sadler and Petts (2000). Where possible all previous positive sites were identified and searched as well as nearby (within 3km) locations with similar characteristics. Hand searches were carried out using the procedure outlined by Andersen (1969) and adapted by Plachter (1986) and Fowles (1989), concentrating on turning stones and capturing beetles using an aspirator. Coverage of the different sediment types across the ERS started from the waterside and worked laterally across the bar towards the upper bank. Extensive pitfall trapping is not an appropriate means of capturing this species as it appears to spend a lot of time near the water, and pitfall traps in this area are generally subjected to repeated flooding and disruption. Moreover, only one capture of *B. testaceum* is known from a pitfall survey (Eyre, 2000).

3.2 Species autecology and habitat

At a large scale, the presence of ERS species is linked to the habitat available on individual patches of ERS (and the amount of ERS) as well as their location within the catchment and the hydrology of the river system (Sadler *et al.*, 2004). Therefore, considerable attention was focused on these variables, using the protocols developed in Sadler and Bell (2002), based on the River Habitat Survey methodology (RHS) employed by the Environment Agency in the UK (Fox *et al.*, 1998; Raven *et al.*, 1998). Sediment size and the overall physical diversity (in terms of variety of sediment type and ERS structure) of the ERS are known to be important, as is the type and amount of vegetation (Andersen, 1978, 1983; Eyre *et al.*, 2001a; Eyre *et al.*, 2001b; Sadler & Petts, 2000). The percentage abundance substrate in each sediment class was estimated to within 5%. The topography of the ERS was considered (1) *simple* if it was flat and had no break of slope, (2) *hummocky* if it had clear mounds of sediments, and (3) *complex* if there was a combination of hummocks, flatter areas, channels, and back waters. The percentage of ERS that was shaded by trees was estimated. Vegetation type was graded as (1) *predominantly bare*, (2) *ruderal* vegetation (mainly annuals and short-lived perennial herbs), (3) *complex* vegetation (exhibiting an abundance of perennials species and trees) and the percentage cover estimated. ERS heterogeneity was estimated by counting the number of microhabitats on each ERS (e.g. silt fringes, sand fringes, back waters, amount of vertical sorting and so on). ERS with many microhabitats scored 3 and ERS with limited microhabitats scored 1. Assessing whether the ERS was trampled and/or excavated for aggregates provided an indication of the amount of 'artificial' disturbance on the ERS (0 = none, 1 = light, 2 = medium, 3 = heavy). The adjacent land use was documented as were any evident features indicating bank management and/or engineering. These data were collected for all sites where samples were taken in the field survey.

Additional data on the bedrock geology and altitude were derived from large scale (1:10,000) maps for all verified records. Photographic and field notebook logs were created during the field survey to assist in data interpretation (Appendices A and B).

3.2.1 Species autecology

To examine the detailed microhabitat occurrence of the species attention was focused upon Areas 1 (River Tyne and its tributaries) and 3 (specifically the River Usk), as these were sites with known extant populations. The sites were surveyed using a Leica Instruments differential GPS to create an accurate Digital Elevation Model (DEM) of the ERS and its main microhabitats. Thereafter, all microhabitats were extensively searched for adult *B. testaceum*. Photographs were taken of the bar, and the detailed microhabitat and sediment descriptions of where the species was found was recorded at each site to help with interpretation of the species requirements. Although present in reasonable numbers at the River Usk the population was too small to undertake Mark Release Recapture (MRR) studies to assess population dynamics (Bates *et al.*, in press).

A brief review of the continental literature was undertaken to examine the ecological tolerances of the species outside of the UK.

4. Results

4.1 Desk study of known records

Table 1 lists all known pre-existing records collated as part of the desk study. In total, there were 39 records covering 15 10km squares of National Grid. Four of these were post 1980 records (Figure 1).

4.1.1 Pre-1980 distribution

Early works such as those of Fowler (1886) and Fowler and Donisthorpe (1913) provided species records from the mid 19th to early 20th century. Fowler (1886) recorded the species from Cobham near Horsell, Surrey (Power), and also in Sussex (Horner). He went on to state, however, that 'as a rule it is a northern species found in the Northumberland district and elsewhere in the north of England and it is locally distributed in Scotland, where it is common in one or two places on the banks of the Nith in the Solway district'. Donisthorpe (in Fowler and Donisthorpe, 1913) provides additional records for 'Devon, on the River Teign (Keys); Llandaff, S. Wales (Tomlin); Mousehold Heath, Norfolk (Edwards); Cumberland; near Glasgow, locally common (Anderson-Fergusson and Adie Dalglish).' Although only a few of these can be found in the database (Table 1), records by Tomlin, Hallett and others from the Taff suggest that the species was formerly abundant around Llandaff at the turn of the 20th century. Additional mid to late 19th century records can be found for Chobham in Surrey (Billups in Tottenham coll.) and the lower Tyne and Derwent (Bold) in Northumberland. A run of early 20th century records exists for the Taff (various collectors), the Yorkshire Derwent (Horrell and Walsh), the Irvine (unattributed collector), the Irthing (Col. Day) and Burwell Wood in Lincolnshire (Biggall). From 1950-1979, the species was recorded from a group of gravel pits at Farnham near Knaresborough in North Yorkshire (Crossley) and a concentration of records from the Tyne and South Tyne (Luff).

There are a number of undated records for the Taff (Anon), and for Totnes (presumably on the River Dart) (Massey coll.) and for Chobham (A. Ford). Many of the Taff specimens derive from the Tomlin collection, and although many are undated, it is reasonable to assume that they orginate from turn of the 20th century.

4.1.2 Post-1980 distribution

The first post-1980 records of *B. testaceum* attest to its continued presence on the Tyne, especially around its confluence with the South Tyne near Hexham (Luff, Hodge) and further downstream around Corbridge near the confluence with the Devil's Water (Reid). A late 1980s record exists from the River Teme just upstream from the tidal limit at Powick, Worcestershire (Whitehead).

Other recent records of the species derive from surveys of the Rivers Usk as part of recent Environment Agency project (Sadler and Bell, 2002), from Hammond's (2003) study of the same river, and from continued work on the rivers of NW England (e.g. Eyre *et al.*, 2000). Prior to the onset of this project

no new records of *B. testaceum* were submitted to the carabid recording scheme managed by Mark Telfer (pers. comm.).

4.2 Museum specimens and record confirmation

Specimens in the following museum collections were examined: The Natural History Museum of London; The National Museum of Wales, The Hope Collection in Oxford, Carlisle Museum, Reading Museum, the collection of the British Entomological and Natural History Society (Dinton Pastures) and Manchester University Museum. This work involved the examination of numerous specimens pertaining to 48 records (Table 2). The work has helped to confirm the specimens from: (i) the Irthing (Day), (ii) the Teme (Easton), (iii) Chobham (Ford and Billups in the Tottenham coll.), (iv) Farnham Gravel Pits, (v) the River 'Monnow', (vi) the River Taff (Tomlin and others in various collections), and (vii) the Dart (BENHS coll). Morgan's record from Cefnblaenau is known to be erroneous and based on a misidentification of *Bembidion tetracolum* (Fowles pers. comm.).

Although a specimen in the National Museum of Wales is labelled 'Scarborough' and presumably relates to the River Derwent or one its tributaries, we were unable to trace specimens from Forge Valley in Yorkshire (Horrell and Walsh) (Table 2). Similarly, despite the varying dates, the specimens captured by Bold located in the Natural History Museum (London) could be the Bold records attributed to the ISR (Tables 1 & 2). The records from Pontneathranghan (carabid database) and Pont Nedd Fechan (CCW data) probably relate to the Afon Neath and may refer to the same locality or possibly the same specimen. An old specimen in the National Museum of Wales labelled 'Pont Neath' may relate to this record.

No specimens have been found in the Power collection to confirm the 'Cobham' records listed in Fowler (1888), and we have seen only one Devon specimen, that for Totnes (BENHS coll.), although a Butler specimen from 'Exmouth' located in Manchester University Museum, was identified by Colin Johnson, suggesting a secure determination. Riggall's record from Burwell wood also remains unverified. The post 1980 records from the Tyne all relate to specimens determined by either Martin Luff or Peter Hodge.

Table 1: Records derived from the desk study

Date	Recorder	Determiner	NGR	10km square	Location	River	Comments	Record Source
1855	T.J. Bold	T.J. Bold	NZ1564	NZ1564	Ryton Willows	Tyne		ISR
1855	T.J. Bold	T.J. Bold	NZ1961	NZ1961	Axwell Park	Derwent, Northumbria		ISR
1887	C.E. Tottenham	M.L. Luff	SU96	SU96	Chobham	? Mill Bourne	Unlikely - small stream in Wey catchment	GB Carabid database
vi.1896	Anon	Anon	ST18	ST18	River Taff	Taff	Dry bed of the river. There are 5 specimens ex. coll. Chaney in the Tomlin Collection	Adrian Fowles CCW database
vii.1896	Anon	Anon	ST1578	ST1578	Llandaff	Taff	There are two specimens ex. coll. Chaney in the Tomlin Collection (NMGW) labelled with these data	Adrian Fowles CCW database
1898	Anon	Anon	ST1578	ST1578	Llandaff	Taff	Liverpool Museum includes 9 specimens from Llandaff.	Adrian Fowles CCW database
1899	Anon	M.L. Luff	ST17	ST17	Llandaff	Taff	Specimens in Welsh National Museum Collection	GB Carabid database
vii.1899	Anon	Anon	ST1578	ST1578	Llandaff	Taff	There are two specimens in the G.W. Chaster Collection (NMGW) labelled with these data	Adrian Fowles CCW database
1913	E.C. Horrell	Anon	SE98	SE98	Forge Valley	Derwent, Yorks		GB Carabid database
26.iv.1902	Anon	Anon	NS33	NS33	Irvine Bay	Irvine	There are two specimens in the Tomlin Collection (NMGW) labelled (Irvine A.) [grid ref. is approximate]	Adrian Fowles CCW database
06.v.1905	F.H. Day	Anon	NY56	NY56	nr. Great Easby, River Irthing	Irthing	Specimen in Carlisle Museum	GB Carabid database
1916	Anon	Anon	SN90	SN90	Pontneathranghan	? Afon Neath	duplicate?	GB Carabid database
14.viii.1916	Anon	Anon	SN90	SN90	Pont Nedd Fechan	? Afon Neath	duplicate?	Adrian Fowles CCW database
02.vi.1923	F.H. Day	Anon	NY5363	NY5363	River Irthing	Irthing	Specimen in Carlisle Museum	GB Carabid database
ix.1933	Anon	Anon	Unknown	Unknown	River Monnow	Monnow	There are two specimens in the Tomlin Collection (NMGW) labelled 'R. Monnow'	Adrian Fowles CCW database
1943	E.C. Riggall	Anon	TF362813	TF362813	Burwell Wood	No visible stream	Another unlikely record. Misidentification?	ISR
1950	G.B. Walsh	Anon	SE982866	SE982866	Forge Valley NNR	Derwent, Yorks		ISR
vii.1976	R. Crossley	R. Crossley	SE338602	SE338602	Farnham Gravel Pits	? River Nidd		ISR
v.1978	M.L. Luff	M.L. Luff	NY96	NY96	Warden, River Tyne confluence	Tyne		GB Carabid database
1979	M.L. Luff	Anon	NY9166	NY9166	Tyne Watersmeet SSSI	Tyne		ISR
v.1979	M.L. Luff	M.L. Luff	NY96	NY96	Warden,R Tyne S bank	South Tyne		GB Carabid database
1981	C.A.M. Reid	Anon	NY9764	NY9764	Dilstonheugh	Tyne		ISR
1982	C.A.M. Reid	Anon	NY9764	NY9764	Corbridge	Tyne		GB Carabid database
28.vii.1982	P.J. Hodge	P.J. Hodge	NY9166	NY9166	Tyne Watersmeet SSSI	Tyne	Confluence N & S Tyne Rivers	ISR
1987	M.L. Luff	M.L. Luff	NY96	NY96	Hexham,Tyne Confluence nr	Tyne		GB Carabid database
05.iv.1989	I.K. Morgan	Unknown	SN579417	SN579417	Cefnblaenau	Nant Ryhd-y-mwyn	Incorrect determination (Fowles pers. comm.)	GB Carabid database
15.vii.1989	P.F. Whitehead	P.F. Whitehead	SO8352	SO8352	Powick	Teme		GB Carabid database
1996	M.D. Eyre	M.L. Luff	NY7864	NY7864	South Tyne near Beltingham	South Tyne	1 specimen in a pitfall, Eyre et al. 2000 - Coleopterist, 9, 25-38	ERS Database
28.v.1998	J.P. Sadler	J.P. Sadler	ST388963	ST388963	River Usk at Llangibby Bottom A2	Usk	3 specimens in a hand search, Sadler & Bell 2000	ERS Phase 3 R & D
23.vii.2000	J. Read	M.L. Luff	NY008173	NY008173	Keekle River, West Cumbria	Keekle	1 specimen, Record not available at the start of the project	Cumbrian Records Centre
25.vi.2003	P.M. Hammond	P.M.Hammond	ST388953	ST388953	Llangybi	Usk	12 specimens hand searched, Hammond 2003	CCW records
25.vi.2003	P.M. Hammond	P.M.Hammond	ST388987	ST388987	Usk 2	Usk	1 specimen hand searched, Hammond 2003	CCW records
Unknown	Anon	Anon	ST17	ST17	River Taff	Taff		GB Carabid database
Unknown	Anon	M.L. Luff	ST17	ST17	Llandaff, River Taff	Taff	Specimen in Newcastle University Collection	GB Carabid database
Unknown	Anon	Anon	ST17	ST17	Llandaff	Taff	In Tomlin collection	GB Carabid database
Unknown	Anon	Anon	ST17	ST17	Llandaff, River Taff	Taff	In Tomlin collection	GB Carabid database
Unknown	Sharp	Anon	ST17	ST17	R Taff	Taff		GB Carabid database
Unknown	A. Ford	Anon	SU96	SU96	Chobham	? Mill Bourne	Unlikely - small stream in Wey catchment	GB Carabid database
9.viii.1936	A.M. Massey	M.L. Luff	?SX86	?SX86	Totnes	Dart	1 specimen in BENHS coll. (Dinton Pastures)	GB Carabid database

4.2.1 New records from museum work

The museum work generated 34 new records. Twenty-two of these are securely dated and originate from the rivers Monnow (R.W. Lloyd), Teme (C.E. Tottenham, A. Easton), Wye (C. E. Tottenham), Irvine (A. Dalglish), Taff (H. Donisthorpe), Nith and its tributaries (D. Sharp), Irthing (G.B. Routeledge), and the Exe (P.M. Butler). Although most of these are from rivers with previous records, the work adds an additional 6 new 10 km squares to the species former distribution on:

1. The River Wye at Symonds Yat (Herefordshire) and Hay-on-Wye, collected by C.E. Tottenham in the 1930s.

2. The River Teme at Shelsley (Worcestershire) collected by C.E. Tottenham in 1934 and from Ham Bridge (Worcestershire) collected by A. Easton in 1967.

3. The River Nith (and tributaries) around Thornhill, collected by D. Sharp in the mid 19th century.

4. A small tributary of the Clyde at Tolls Cross in Lanarkshire, collected by W. Holland. Although the exact date of the capture is unknown, Holland was active between 1890 and 1915. It seems reasonable to assume that the specimen dates to this period.

5. The River Keekle in West Cumbria in 2000 (John Read, det. Martin Luff) (Steven Hewitt pers. comm. – Carlisle Biological Records Centre).

4.3 Field surveys

Field surveys were carried out in 125 separate locations within the five areas selected for examination during May-September 2004 (Table 3). This totalled 44 person days of survey and associated hand searching. Specific details of the fieldwork and lists of other species captured at the field sites are provided in the fieldwork diaries reproduced in Appendices A & B. The survey work covered 34 10 km squares and included all known previous locations other than those identified in the summer during the museum work, namely those on the Wye (Tottenham record) and the Nith and tributaries (Sharp) and the Keekle (J. Read). The survey work provided a total of 17 new records and confirms current extant populations from seven 10km squares on the Rivers, Usk, Monnow, Teme, South Tyne, Devil's Water and Tyne (Table 4).

Table 2: Records confirmed in museum collections

Record Date	Recorder	Determiner	NGR	10km square	Location	River	Specimen location	Comments	Named as	Examined
Unknown	Bates	No data	No data		No data	Unknown	Natural History Museum, London	1 specimen, H. Dollman collection	B. testaceum	Peter Hammond
Unknown	O.E. Janson	No data	No data		No data	Unknown	Natural History Museum, London	1 specimen, Saunders collection	B. testaceum	Peter Hammond
19.vi.1911	H. Donisthorpe	H. Donisthorpe	No data	ST17	Llandaff	Taff	Natural History Museum, London	6 specimens	B. testaceum	Peter Hammond
28.ix.1864	T.J. Bold	No data	No data		? Northumberland	Unknown	Natural History Museum, London	1 specimen	B. testaceum	Peter Hammond
Unknown	T.J. Bold	No data	No data		Manchester	Unknown	Natural History Museum, London	1 specimen, J. Power collection	B. testaceum	Peter Hammond
Unknown	No data	No data	No data		No data	Unknown	Natural History Museum, London	7 specimens, J. Power collection	B. testaceum	Peter Hammond
Unknown	Ex. J. Power	No data	No data		No data	Unknown	Natural History Museum, London	3 specimens, T. Wood collection	B. testaceum	Peter Hammond
Unknown	D. Sharp	D. Sharp	No data	?X98	Dumfries	Unknown	Natural History Museum, London	2 specimens	B. testaceum	Peter Hammond
11.ix.1867	D. Sharp	D. Sharp	No data	NX98	Nith Banks	Nith	Natural History Museum, London	3 specimens	B. testaceum	Peter Hammond
18.ix.1867	D. Sharp	D. Sharp	No data	NX98	Crickhope Burn (Dumfries)	Crickhope Burn	Natural History Museum, London	4 specimens	B. testaceum	Peter Hammond
25.ix.1867	D. Sharp	D. Sharp	No data	NX98	Nith Banks, near Waterside	Nith	Natural History Museum, London	3 specimens	B. testaceum	Peter Hammond
29.iii.1869	D. Sharp	D. Sharp	No data	NX98	Nith Banks	Nith	Natural History Museum, London	4 specimens	B. testaceum	Peter Hammond
24.ix.1867	D. Sharp	D. Sharp	No data	NX98	Banks of Nith	Nith	Natural History Museum, London	1 specimen	B. testaceum	Peter Hammond
1.v.1869	D. Sharp	D. Sharp	NX8795	NX98	Thornhill, banks of the Nith	Nith	Natural History Museum, London	4 specimens	B. testaceum	Peter Hammond
31.v.1934	C.E. Tottenham	C.E. Tottenham	SO7362	SO76	Shelsley, Worcs	Teme	Natural History Museum, London	2 specimens	Not named	Peter Hammond
11.vi.1935	C.E. Tottenham	C.E. Tottenham	SO5516	SO51	Symonds Yat, Herefords	Wye	Natural History Museum, London	3 specimens	Not named	Peter Hammond
5.iv.1969	A. Easton	A. Easton	ST3996	ST3996	Llantrisant, Usk banks	Usk	Natural History Museum, London	2 specimens	Not named	Peter Hammond
20.v.1967	A. Easton	A. Easton	SO7559	SO7559	Ham Bridge, Teme banks	Teme	Natural History Museum, London	2 specimens	Not named	Peter Hammond
1.vi.1939	C.E. Tottenham	C.E. Tottenham	SO2342	SO2342	Hay-on-Wye	Wye	Natural History Museum, London	1 specimen	B. tetracolum	Peter Hammond
8.viii?1859	T.R. Billups	T.R. Billups	No data	?SU96	Chobham, Surrey	Unknown	Natural History Museum, London	2 specimens	B. tetracolum	Peter Hammond
Unknown	No data	No data	No data		No data	Unknown	Hope Collections, Oxford Museum	1 specimen, Tylden collection	B. testaceum	Peter Hammond
Unknown	No data	No data	No data		No data	Unknown	Hope Collections, Oxford Museum	2 specimens, H.E. Cox collection	B. testaceum	Peter Hammond
Unknown	No data	No data	No data	ST17	Llandaff	Taff	Hope Collections, Oxford Museum	18 specimens	B. testaceum	Peter Hammond
20.vii.1897	No data	No data	No data	ST17	Llandaff	Taff	Hope Collections, Oxford Museum	1 specimen	B. testaceum	Peter Hammond
27.vii.1897	No data	No data	No data	ST17	Llandaff	Taff	Hope Collections, Oxford Museum	2 specimens	B. testaceum	Peter Hammond
vii.1899	No data	No data	No data	ST17	Llandaff	Taff	Hope Collections, Oxford Museum	4 specimens, Ex. Tomlin	B. testaceum	Peter Hammond
Unknown	W. Holland	No data	NS6463	NS6463	Tolls Cross, Lanarks	small trib. of Clyde	Hope Collections, Oxford Museum	1 specimen	B. testaceum	Peter Hammond
23.v.1904	A.A. Dalglish	A.A. Dalglish	NS3239	NS3239	Irvine	Irvine	Hope Collections, Oxford Museum	6 specimens	B. testaceum	Peter Hammond
23.vi.1904	A.A. Dalglish	A.A. Dalglish	No data	NS33	Irvine	Irvine	Hope Collections, Oxford Museum	1 specimen	B. testaceum	Peter Hammond
19.v.1908	A.A. Dalglish	A.A. Dalglish	No data	NS33	Irvine	Irvine	Hope Collections, Oxford Museum	2 specimens	B. testaceum	Peter Hammond
21.v.1908	A.A. Dalglish	A.A. Dalglish	No data	NS33	Irvine	Irvine	Hope Collections, Oxford Museum	1 specimen	B. testaceum	Peter Hammond
					Llandaff	Taff	National Museum of Wales	Many specimens	B. testaceum	Peter Hammond in 2003
Unknown	No data	No data	No data		Pont Neath	Unknown	National Museum of Wales	One old specimen	B. testaceum	Peter Hammond in 2003
Unknown	No data	No data	No data	?SE98	Scarborough	? Derwent, Yorks.	National Museum of Wales		B. testaceum	Peter Hammond in 2003
Unknown	No data	No data	No data		River Monnow	Monnow	National Museum of Wales	old specimens	B. testaceum	Peter Hammond in 2003
Unknown	D. Sharp	D. Sharp	No data	NX98	Thornhill, banks of the Nith	Nith	Manchester University Museum		B. testaceum	Colin Johnson in 1982
3.vii.1944	R.W. Lloyd	R.W. Lloyd	SO3929	SO32	Llangua, Monmouths	Monnow	Manchester University Museum		B. testaceum	Colin Johnson in 1982
viii.1951	P.M. Butler	P.M. Butler	No data		Exmouth	Exe	Manchester University Museum		B. testaceum	Colin Johnson in 1982
29.ix.1980	M.L. Luff	M.L. Luff	NY9265	NY96	Warden, South Tyne	South Tyne	Manchester University Museum		B. testaceum	Colin Johnson in 1982
Unknown	A. Ford	A. Ford	No data	?SU96	Chobham	Unknown	Manchester University Museum		B. testaceum	Colin Johnson in 1982
Unknown	W.S. Bagnal	No data	No data		Northumberland	Unknown	Manchester University Museum		B. testaceum	Colin Johnson in 1982
Unknown	T.H. Edmonds	No data	No data		River Taff	Taff	Manchester University Museum		B. testaceum	Colin Johnson in 1982
Unknown	E.S. Gorham	Gorham	No data		Unknown	Unknown	Birmingham University	2 specimens, in Gorham collection. Coded labels - no data	B. testaceum	Jon Sadler
Unknown	No data	No data	No data		Unknown	Unknown	Carlisle Museum	1 specimen, G.B. Routledge collection (ex. G.A. Lewcock)	B. testaceum	Jon Sadler
1897	J.R. leB. Tomlin	No data	No data	ST18	Llandaff	Taff	Carlisle Museum	2 specimens, G.B. Routledge collection	B. testaceum	Jon Sadler
Unknown	W.H. Harwood	No data	No data		Llandaff	Taff	Carlisle Museum	1 specimen, G.B. Routledge collection	B. testaceum	Jon Sadler
9.vii.1905	G.B. Routledge	G.B. Routledge	NY4960	NY4960	Ruleholme, River Irthing	Irthing	Carlisle Museum	1 specimen, G.B. Routledge collection	B. testaceum	Jon Sadler
9.viii.1936	T.H. Edwards	Peter Hammond	SX86	SX86	Totnes	Dart	BENHS coll. At Dinton Pastures	1 specimen, BENHS coll.	B. testaceum	Peter Hammond

Table 3: Sites selected for survey work

Date	NGR	Sample Area	River	Former Records	Investigators
1.vi.2004	ST175551	3	Taff	Numerous in both database and museums	Peter Hammond
	ST174772	3			Peter Hammond
	ST171780	3			Peter Hammond
	ST162782	3			Peter Hammond
2.vi.2004	ST155784	3			Peter Hammond
	ST152785	3			Peter Hammond
	ST153783	3			Peter Hammond
	ST117768-ST122772	3	Ely		Peter Hammond
17.vi.2004	SO728628	3	Teme	P.F. Whitehead, A. Easton	Peter Hammond
	SO729625	3			Peter Hammond
	SO728624	3			Peter Hammond
	SO737612	3			Peter Hammond
	SO737611	3			Peter Hammond
	SO737611	3			Peter Hammond
	SO745603	3			Peter Hammond
28.vii.2004	SO715658	3	Teme	A. Easton	Peter Hammond and David Bell
	SO715657	3			Peter Hammond and David Bell
	SO728628	3			Peter Hammond and David Bell
	SO733559	3			Peter Hammond and David Bell
	SO479172	3	Monnow	R.W. Lloyd	Peter Hammond and David Bell
	SO479171	3			Peter Hammond and David Bell
29.vii.2004	SO507130	3			Peter Hammond and David Bell
	SO512129	3	Wye	C.E. Tottenham	Peter Hammond and David Bell
	ST386966	3	Usk	A. Easton, J.P. Sadler, P.M. Hammond	Peter Hammond and David Bell
	ST397964	3			Peter Hammond and David Bell
	ST388953	3			Peter Hammond and David Bell
	ST386956-ST386951	3			Peter Hammond and David Bell
26.viii.2004	ST325025-SY283973	4	Axe	None – Devon records relate to the Teign, Dart and Exe	Peter Hammond & Beth Okamura
	SY282978	4	Yarty		Peter Hammond & Beth Okamura
	SY095955-SY09939	4	Otter		Peter Hammond & Beth Okamura
	SX858734-SX852748	4	Teign	Fowler and Donisthorpe	Peter Hammond & Beth Okamura
27.viii.2004	SX733705	4	Dart	A.M. Massey	Peter Hammond & Beth Okamura
	SX748661	4			Peter Hammond & Beth Okamura
	SX806602	4			Peter Hammond & Beth Okamura
	SX800614-SX807608	4			Peter Hammond & Beth Okamura
	SX778635-SX785638	4			Peter Hammond & Beth Okamura
	SX784636	4			Peter Hammond & Beth Okamura
28.viii.2004	SX855746-SX849758	4	Teign	Fowler and Donisthorpe	Peter Hammond & Beth Okamura
	SX914922-SS952121	4	Exe	P.M. Butler	Peter Hammond & Beth Okamura
5.ix.2004	SU974620-SU993619	5	Mill Bourne	Billups (ex. Tottenham coll), A. Ford	Peter Hammond & Beth Okamura

Table 3 (continued)

Date	NGR	Sample Area	River	Former Records	Investigators
	TQ068647-TQ063635	5	Wey		Peter Hammond & Beth Okamura
5.viii.2004	SE338602	2	Farnham Gravel Pits	R. Crossley	David Bell
	SE349599	2			David Bell
	SE351593	2			David Bell
	SE358590	2			David Bell
	SE360579	2			David Bell
	SE188458	2	Otley Gravel Pits		David Bell
	SE192454	2			David Bell
6.viii.2004	SE800727	2	Derwent (Yorks)	E.C. Horrell, G.B. Walsh	David Bell
	SE809760	2	Rye (trib. Of Derwent)		David Bell
	SE748760	2			David Bell
	SE731775	2			David Bell
	SE742782	2	Seven		David Bell
	SE892769	2	Derwent (Yorks)		David Bell
	SE953794	2			David Bell
	SE993841	2			David Bell
	SE993839	2			David Bell
	SE995836	2			David Bell
	SE988848	2			David Bell
	SE984871-SE938921	2			David Bell
7.viii.2004	NY540633	1	Irthing	F.H. Day	David Bell
	NY539633	1			David Bell
	NY538632	1			David Bell
	NY537632	1			David Bell
	NY535633	1			David Bell
8.viii.2004	NY520631	1			David Bell
	NY523632	1			David Bell
	NY524633	1	Irthing/Kings Water confluence		David Bell
	NY524633	1	Kings Water		David Bell
	NY533634	1	Irthing		David Bell
	NY533632	1			David Bell
	NY535635	1			David Bell
9.viii.2004	NY785640	1	South Tyne	M.D. Eyre, M.L. Luff	David Bell
	NY790642	1			David Bell
	NY800587	1	Allen	None but suitable habitat	David Bell
	NY800588	1	Allen	None but suitable habitat	David Bell
	NY918660	1	Tyne	M.D. Eyre, M.L. Luff and numerous others	David Bell

Table 3 (continued)

Date	NGR	Sample Area	River	Former Records	Investigators
17.viii.2004	NY910659	1	South Tyne	M.L. Luff	David Bell
	NY900666	1	South Tyne		David Bell
	NY918660	1	Tyne	P.J. Hodge, M.L. Luff	David Bell
18.viii.2004	NY975643	1	Devil's Water	C.A.M. Reid	David Bell
	NY975644	1	Tyne/Devil's Water confluence		David Bell
	NY975635	1	Devil's Water		David Bell
	NY955616	1	Devil's Water		David Bell
	NT991313-NT985320	1	Till	None but suitable habitat	David Bell
25.viii.2004	NZ188611-NZ198623	1	Derwent (Northumbria)	T.J. Bold	David Bell
	NZ151650	1	Tyne	T.J. Bold	David Bell
	NZ157649	1	Tyne		David Bell
	NZ155649	1	Tyne		David Bell
2.ix.2004	ST385966	3	Usk	A. Easton, J.P. Sadler, P.M. Hammond	David Bell, Jon Sadler and Adam Bates
	ST385966	3	Usk	A. Easton, J.P. Sadler, P.M. Hammond	David Bell, Jon Sadler and Adam Bates
	ST388952	3	Usk	A. Easton, J.P. Sadler, P.M. Hammond	David Bell, Jon Sadler and Adam Bates
	SO728627	3	Teme	A. Easton	David Bell, Jon Sadler and Adam Bates
23.ix.2004	NY975643	1	Devil's Water	C.A.M. Reid	David Bell, Jon Sadler and Adam Bates
	NY975635	1	Devil's Water	C.A.M. Reid	David Bell, Jon Sadler and Adam Bates
	NY918660	1	Tyne	M.D. Eyre, M.L. Luff and numerous others	David Bell, Jon Sadler and Adam Bates
	NY790642	1	South Tyne	M.D. Eyre, M.L. Luff	David Bell, Jon Sadler and Adam Bates

Table 4: New records derived from the survey work

Date	Recorder	Determiner	NGR	Location	River	Comments
17.vi.2004	Peter Hammond	Peter Hammond	SO728627	Shelsley Beauchamp bank	Teme	Right bank, c. 30m long. Mainly cobble with collapsed sand at bank edge
28.vii.2004	David Bell	David Bell	SO728627	Shelsley Beauchamp bank	Teme	Right bank, c. 30m long. Mainly cobble with collapsed sand at bank edge
28.vii.2004	David Bell	David Bell	SO715656	Stanford Bridge	Teme	Low-lying but clean bar downstream from bridge
28.vii.2004	David Bell	David Bell	SO477172	Tregate Bridge	Monnow	Small ERS downstream of collapsed weir
28.vii.2004	Peter Hammond	Peter Hammond	SO728627	Shelsley Beauchamp bank	Teme	Right bank, c. 30m long. Mainly cobble with collasped sand at bank edge
29.vii.2004	Peter Hammond	Peter Hammond	ST388953	Llangibby Bottom A	Usk	Left Bank, large complex bar with variable sediments and habitats
29.vii.2004	Peter Hammond	Peter Hammond	ST387964	Usk site 11 (PMH)	Usk	Left Bank, large complex bar with variable sediments and habitats
29.vii.2004	David Bell	David Bell	ST388953	Upstream of Llangibby A	Usk	Left Bank, Narrow lateral bar - 300m upstream of main point bar
29.vii.2004	David Bell	David Bell	ST388953	Llangibby Bottom A	Usk	Left Bank, large complex bar with variable sediments and habitats
29.vii.2004	David Bell	David Bell	ST388952	Llangibby Bottom B	Usk	Left Bank, Complex bar with lots of sand and variable sediments. Heavily livestock trampled
16.viii.2004	David Bell	David Bell	NY785640	Beltingham	South Tyne	Large diverse ERS, wood and variable substrate
17.viii.2004	David Bell	David Bell	NY918660	River Tyne - confluence	Tyne	Site 6. Small trampled ERS. Fine sands and pebbles, flat and low-lying
18.viii.2004	David Bell	David Bell	NY975643	River Devil's Water	Devil's Water	Tributary of Tyne. Cobble/boulder with coarse grit fining to sand
2.ix.2004	Jon Sadler	Jon Sadler	ST388953	Llangibby Bottom A	Usk	Left Bank, large complex bar with variable sediments and habitats
2.ix.2004	David Bell	David Bell	ST388953	Llangibby Bottom A	Usk	Left Bank, large complex bar with variable sediments and habitats
2.ix.2004	Adam Bates	Adam Bates	ST385963	Llangibby Bottom A cliff	Usk	Steep eroding clay cliff with narrow band of shingle over sand, downstream of Llangibby A
2.ix.2004	Jon Sadler	Jon Sadler	ST385963	Llangibby Bottom A cliff	Usk	Steep eroding clay cliff with narrow band of shingle over sand, downstream of Llangibby A

4.4 Current Status and Distribution

Combining the museum work with the fieldwork provides a consolidated list of 74 records if one excludes records have no dates and no location data (Table 5). The species now has records from 26 10km squares of which seven are for the post-1980 period, and one remains undated. Taken at face value the records suggest a large-scale reduction in range, especially when comparing both the post- and pre-1980 records and the number of 10km record squares (Figure 2).

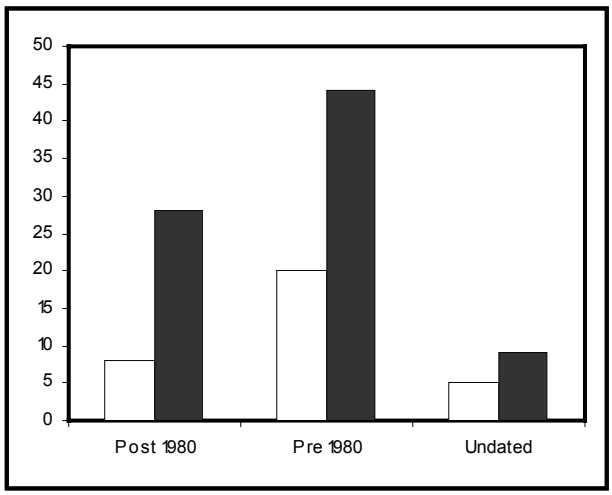

Figure 2: The number of records (black) and 10km squares (White) for *B. testaceum* (data derived from Table 5)

However, one might expect a wider distribution in the past merely to be related to the amount of sampling. The records in the database range from 1855 to the present day, which is exactly 150 years of sampling. Utilising 1980 as a cut-off to assess current status entails comparing the last 25 years of sampling against the former 125 years.

It is not too surprising therefore that there is almost double the number of records and 10km squares pre-1980 than post-1980. In contrast, an examination of the records during 25 year slices since 1855 (Figure 3) illustrates that the species appears to have remained relatively stable. The number of records ranges between 6-13 until the post -1980 period when it dramatically increases to 28. The number of recorded 10km squares rises steady until 1930 from 3 to 7, drops to 3 between 1930 – 1955 and recovers back to 7 post 1980. These data suggest that over the time the species distribution has remained relatively stable. However, if one examines the geographical location of these records (Figure 4), a very different picture emerges and there is a marked variation by river catchment. Although, the number of post-1980 records and squares has increased, most of these are in a few river catchments that have a run of historical records, namely, the Rivers Usk and Monnow in Wales and the Teme, Tyne and South Tyne in England. The only new river is the Keekle in west Cumbria where the one specimen was collected in 2000. Perhaps significantly, the species has not been found recently in a number of areas where it was formerly recorded, namely in Wales (Taff and Wye), in England (Yorkshire and Northumbria Derwent and the

Irthing) and in SW Scotland (the Nith and its tributaries and the Clyde catchment) (Figure 5).

Table 5: Consolidated list of records

Record Date	Recorder	Determiner	NGR	Location	River	data	Altitude (m)	Geology	Rock Type
1855	T.J. Bold	T.J. Bold	NZ1564	Ryton Willows	Tyne	Database	8	Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
1855	T.J. Bold	T.J. Bold	NZ1961	Axwell Park	Derwent, Northumbria	Database	8	Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
8.viii?1859	T. Billups	T. Billups	SU9761	Chobham, Surrey	? Mill Bourne	Museum	25	Barton and Bagshot Beds (Tertiary)	Pebbles and sands
11.ix.1867	D. Sharp	D. Sharp	No data	Nith Banks	Nith	Museum	40	Lower Old Red Sandstone	Sandstone
18.ix.1867	D. Sharp	D. Sharp	No data	Crickhope Burn (Dumfries)	Crickhope Burn	Museum	65	Lower Old Red Sandstone	Sandstone
25.ix.1967	D. Sharp	D. Sharp	No data	Nith Banks, near Waterside	Nith	Museum	40	Lower Old Red Sandstone	Sandstone
29.iii.1868	D. Sharp	D. Sharp	No data	Nith Banks	Nith	Museum	40	Lower Old Red Sandstone	Sandstone
24.ix.1868	D. Sharp	D. Sharp	No data	Banks of Nith	Nith	Museum	40	Lower Old Red Sandstone	Sandstone
1.v.1869	D. Sharp	D. Sharp	NX8795	Thornhill, banks of the Nith	Nith	Museum	40	Lower Old Red Sandstone	Sandstone
1887	C.E. Tottenham	M.L. Luff	SU96	Chobham	? Mill Bourne	Database		Barton and Bagshot Beds (Tertiary)	Sandstone
vi.1896	Anon	Anon	ST17	River Taff	Taff	Database		Old Red Sandstones	Sandstone
vii.1896	Anon	Anon	ST1578	Llandaff	Taff	Database	15	Old Red Sandstones	Sandstone
20.vii.1897	No data	No data	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
27.vii.1897	No data	No data	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
1897	Tomlin	No data	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
1898	Anon	Anon	ST1578	Llandaff	Taff	Database	15	Old Red Sandstones	Sandstone
vii.1899	Anon	Anon	ST1578	Llandaff	Taff	Database	15	Old Red Sandstones	Sandstone
1899	Anon	M.L. Luff	ST17	Llandaff	Taff	Database		Old Red Sandstones	Sandstone
vii.1899	No data	No data	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
26.iv.1902	Anon	Anon	NS33	Irvine Bay	Irvine	Database		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
23.v.1904	A.A. Dalglish	A.A. Dalglish	NS3239	Irvine	Irvine	Museum	10	Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
23.vi.1904	A.A. Dalglish	A.A. Dalglish	No data	Irvine	Irvine	Museum		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
06.v.1905	F.H. Day	Anon	NY56	nr. Great Easby, River Irthing	Irthing	Database		St Bees Sandstone (Tertiary)	Sandstone
9.vii.1905	G.B. Routledge	G.B. Routledge	NY4960	Ruleholme, River Irthing	Irthing	Museum	25	St Bees Sandstone (Tertiary)	Sandstone
19.v.1908	A.A. Dalglish	A.A. Dalglish	No data	Irvine	Irvine	Museum		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
21.v.1908	A.A. Dalglish	A.A. Dalglish	No data	Irvine	Irvine	Museum		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
19.vi.1911	H. Donisthorpe	H. Donisthorpe	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
1913	E.C. Horrell	Anon	SE98	Forge Valley	Derwent, Yorks	Database		Clays (Upper Jurassic)	? Clay
14.viii.1916	Anon	Anon	SN90	Pont Nedd Fechan	? Afon Neath	Database		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
1916	Anon	Anon	SN90	Pontneathranghan	? Afon Neath	Database		Westphalian Coalmeasures (Upper Carboniferous)	Sandstone
02.vi.1923	F.H. Day	Anon	NY5363	River Irthing	Irthing	Database	40	St Bees Sandstone (Tertiary)	Sandstone
31.v.1934	C.E. Tottenham	C.E. Tottenham	SO7362	Shelsley, Worcs	Teme	Museum	35	Old Red Sandstone (Upper Devonian)	Sandstone
11.vi.1935	C.E. Tottenham	C.E. Tottenham	SO5516	Symonds Yat, Herefords	Wye	Museum	20	Breconian Sandstone (Lower Devonian)	Sandstone
9.viii.1936	T.H. Edwards	Peter Hammond	SX86	Totnes	Dart	Database			
1.vi.1939	C.E. Tottenham	C.E. Tottenham	SO2342	Hay-on-Wye	Wye	Museum	75	Old Red Sandstone (Upper Devonian)	Sandstone
1943	E.C. Riggall	Anon	TF362813	Burwell Wood	No visible stream	Database	70	Chalk (Cretaceous)	Chalk
3.vii.1944	R.W. Lloyd	R.W. Lloyd	SO3929	Llangua, Monmouths	Monnow	Museum	75	Downtonian Mudstones (Silurian)	Sand, mud and siltstone
1950	G.B. Walsh	Anon	SE982866	Forge Valley NNR	Derwent, Yorks	Database	36	Clays (Upper Jurassic)	? Clay
viii.1951	P.M. Butler	P.M. Butler	No data	Exmouth	Exe	Museum			
20.v.1967	A. Easton	A. Easton	SO7559	Ham Bridge, Teme banks	Teme	Museum	35	Old Red Sandstone (Upper Devonian)	Sandstone
5.iv.1969	A. Easton	A. Easton	ST3996	Llantrisant, Usk banks	Usk	Museum	10	Lower Old Red Sandstone	Sandstone
vii.1976	R. Crossley	R. Crossley	SE338602	Farnham Gravel Pit	Nearest river - Nidd	Database	40	Sherwood Stones (Triassic)	Sandstone
v.1978	M.L. Luff	M.L. Luff	NY96	Warden, River Tyne confluence	Tyne	Database	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
v.1979	M.L. Luff	M.L. Luff	NY96	Warden,R Tyne S bank	South Tyne	Database	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
1979	M.L. Luff	Anon	NY9166	Tyne Watersmeet SSSI	Tyne	Database	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
29.ix.1980	M.L. Luff	M.L. Luff	NY9265	Warden, South Tyne	South Tyne	Museum	35	Upper Limestone group (Upper Carboniferous)	Gritty limestones
1981	C.A.M. Reid	Anon	NY9764	Dilstonheugh	Tyne	Database	30	Upper Limestone group (Upper Carboniferous)	Gritty limestones
28.vii.1982	P.J. Hodge	P.J. Hodge	NY9166	Tyne Watersmeet SSSI	Tyne	Database	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
1982	C.A.M. Reid	Anon	NY9764	Corbridge	Tyne	Database	30	Upper Limestone group (Upper Carboniferous)	Gritty limestones
1987	M.L. Luff	M.L. Luff	NY96	Hexham,Tyne Confluence nr	Tyne	Database	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
15.vii.1989	P.F. Whitehead	P.F. Whitehead	SO8352	Powick	Teme	Database	10	Old Red Sandstone (Upper Devonian)	Sandstone
1996	M.D. Eyre	M.L. Luff	NY7864	South Tyne near Beltingham	South Tyne	Database	80	Upper Limestone group (Upper Carboniferous)	Gritty limestones

Table 5 (continued)

Record Date	Recorder	Determiner	NGR	Location	River	data	Altitude (m	Geology	Rock Type
28.v.1998	J.P. Sadler	J.P. Sadler	ST388963	River Usk at Llangibby Bottom A2	Usk	Database	10	Lower Old Red Sandstone	Sandstone
23.vii.2000	J. Reid	M.L. Luff	NY008173	Keekle River, West Cumbria	Keekle	Database	70	St Bees Sandstone (Tertiary)	Sandstone
25.vi.2003	P.M. Hammond	P.M.Hammond	ST388953	Llangybi	Usk	Database	19	Lower Old Red Sandstone	Sandstone
25.vi.2003	P.M. Hammond	P.M.Hammond	ST388987	Usk 2	Usk	Database	13	Lower Old Red Sandstone	Sandstone
17.vi.2004	Peter Hammond	Peter Hammond	SO728627	Shelshey Beauchamp bank	Teme	Survey	32	Old Red Sandstone (Upper Devonian)	Sandstone
28.vii.2004	David Bell	David Bell	SO728627	Shelshey Beauchamp bank	Teme	Survey	32	Old Red Sandstone (Upper Devonian)	Sandstone
28.vii.2004	David Bell	David Bell	SO715656	Stanford Bridge	Teme	Survey	40	Old Red Sandstone (Upper Devonian)	Sandstone
28.vii.2004	David Bell	David Bell	SO477172	Tregate Bridge	Monnow	Survey	31	Old Red Sandstone (Upper Devonian)	Sandstone
28.vii.2004	Peter Hammond	Peter Hammond	SO728627	Shelshey Beauchamp bank	Teme	Survey	32	Old Red Sandstone (Upper Devonian)	Sandstone
29.vii.2004	Peter Hammond	Peter Hammond	ST388953	Llangibby Bottom A	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
29.vii.2004	Peter Hammond	Peter Hammond	ST387964	Usk site 11 (PMH)	Usk	Survey	8	Lower Old Red Sandstone	Sandstone
29.vii.2004	David Bell	David Bell	ST388953	Upstream of Llangibby A	Usk	Survey	12	Lower Old Red Sandstone	Sandstone
29.vii.2004	David Bell	David Bell	ST388953	Llangibby Bottom A	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
29.vii.2004	David Bell	David Bell	ST388952	Llangibby Bottom B	Usk	Survey	8	Lower Old Red Sandstone	Sandstone
16.viii.2004	David Bell	David Bell	NY785640	Beltingham	South Tyne	Survey	80	Upper Limestone group (Upper Carboniferous)	Gritty limestones
17.viii.2004	David Bell	David Bell	NY918660	River Tyne - confluence	Tyne	Survey	40	Upper Limestone group (Upper Carboniferous)	Gritty limestones
18.viii.2004	David Bell	David Bell	NY975643	River Devil's Water	Devil's Water	Survey	28	Upper Limestone group (Upper Carboniferous)	Gritty limestones
2.ix.2004	Jon Sadler	Jon Sadler	ST388953	Llangibby Bottom A	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
2.ix.2004	David Bell	David Bell	ST388953	Llangibby Bottom A	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
2.ix.2004	Adam Bates	Adam Bates	ST385963	Llangibby Bottom A cliff	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
2.ix.2004	Jon Sadler	Jon Sadler	ST385963	Llangibby Bottom A cliff	Usk	Survey	10	Lower Old Red Sandstone	Sandstone
Unknown	Anon	Anon	ST17	River Taff	Taff	Database		Old Red Sandstones	Sandstone
Unknown	Anon	M.L. Luff	ST17	Llandaff, River Taff	Taff	Database		Old Red Sandstones	Sandstone
Unknown	Anon	Anon	ST17	Llandaff	Taff	Database		Old Red Sandstones	Sandstone
Unknown	Anon	Anon	ST17	Llandaff, River Taff	Taff	Database		Old Red Sandstones	Sandstone
Unknown	Sharp	Anon	ST17	R Taff	Taff	Database		Old Red Sandstones	Sandstone
Unknown	A. Ford	Anon	SU96	Chobham	?Mill bourne	Database		Barton and Bagshot Beds (Tertiary)	Pebbles and sands
Unknown	No data	No data	No data	Llandaff	Taff	Museum		Old Red Sandstones	Sandstone
Unknown	W. Holland	No data	NS6463	Tolls Cross, Lanarks	small trib. of Clyde	Museum	45	Namurian Millstone grits (Carboniferous)	Gritstone

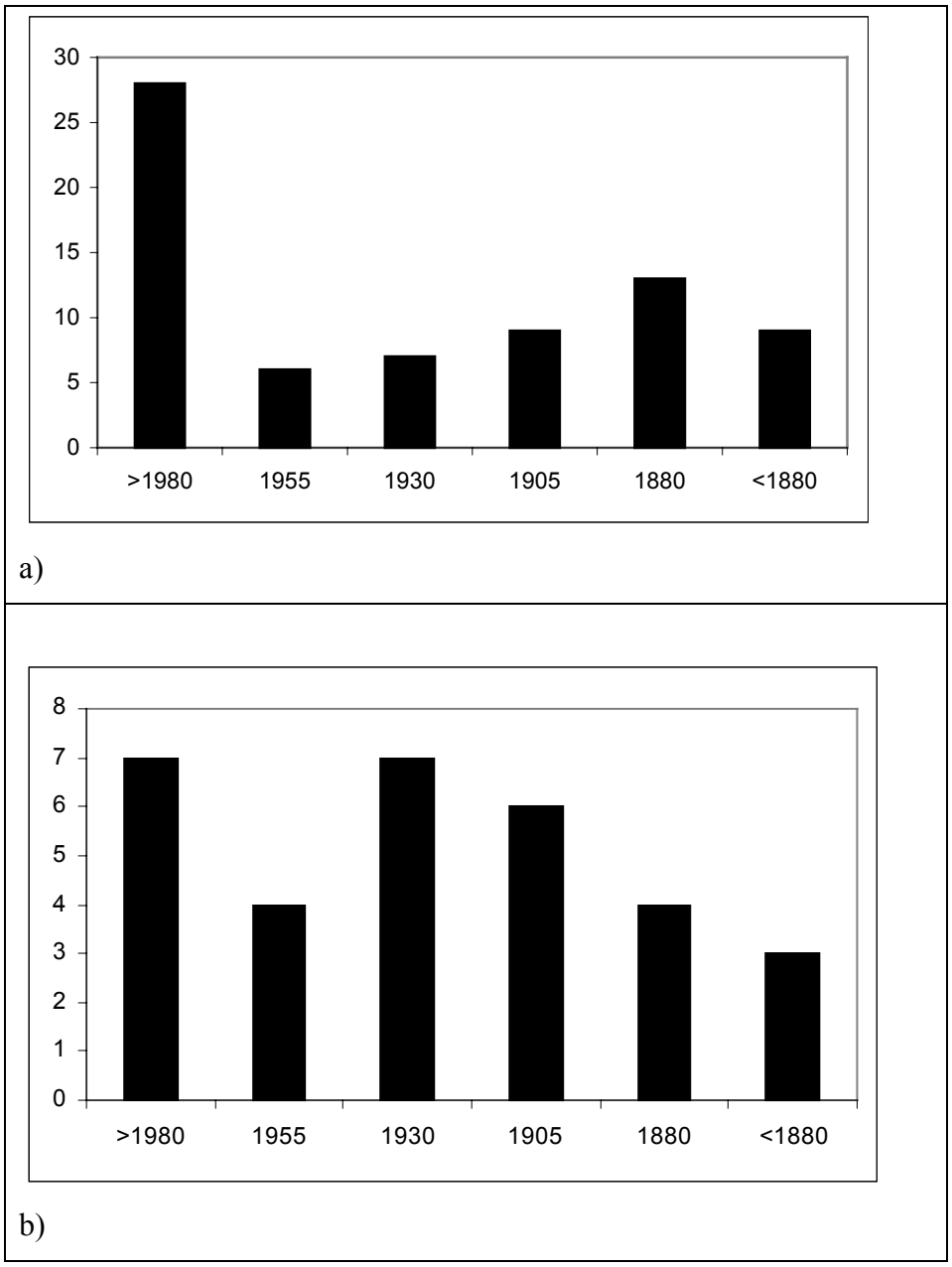

Figure 3: Temporal changes in the Number of records (a) and number of 10km Squares (b) for *Bembidion testaceum*

Interestingly, at this large scale the species' distribution is (almost exclusively) tied to hard rock geology that encompasses coarse sands and grits (Table 5). All confirmed records of the species are associated with Tertiary sandstones and pebbles and sands (Cumbria: Irthing and Keekle) Surrey (Chobham), Triassic sandstones (west Yorkshire: Farnham) and Devonian Old Red Sandstones (Wales: Usk, Monnow, Taff and Wye, the Welsh borders: Teme and parts of Scotland: Nith). There are also numerous records relating to the more complex geology associated with gritstones, sandstones and limestones of the Upper Carbonifierous coal measures (Irvine, Clyde, and Tyne). The as yet unconfirmed records from Burwell Wood in Lincolnshire are on Cretaceous chalk and Upper Jurassic clays (River Derwent).

4.5 European distribution

Bembidion testaceum is widely distributed in central and southern continental Europe. Horion (1941) records it as present in western, middle and southern Europe and as being widespread although rare in Germany. Lucht (1987) lists species records from Germany, Poland, Austria, Czechoslovakia, Northern Switzerland, Eastern France and the Benelux countries, but absent from

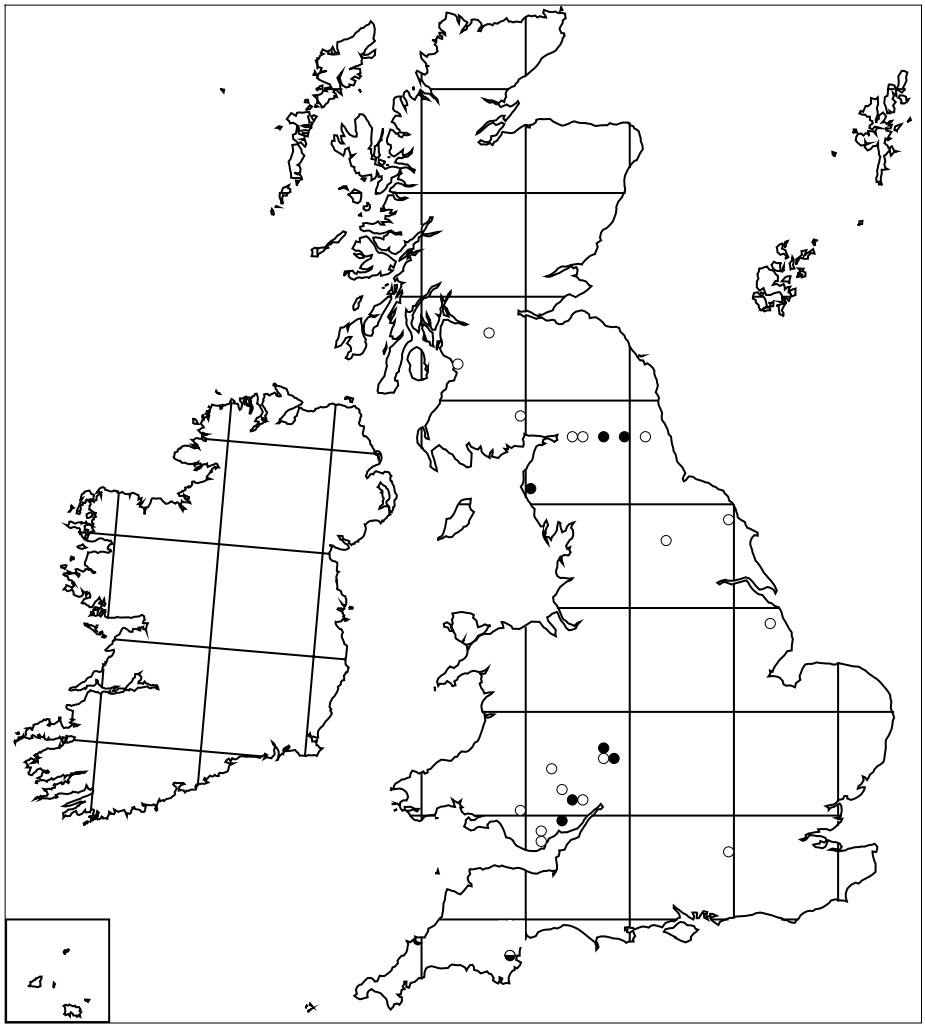

Figure 4: Current distribution map for *B. testaceum* (Data source: Table 5). Black circles are post 1980 records, open circles are pre 1980 and half-filled circles are records with an unknown date

Denmark, southern Sweden, Spain and Portugal, a similar range of countries as in Turin (2000). It is interesting to note that some Central European authors emphasise the species' occurrence in alpine regions (Horion, 1941), whereas this is not evident from Jeannel (1942), who only records the species for Normandy, and the whole of the Loire valley. Similarly, Turin (2000) highlights its associations with the low elevations, especially around the Rhine delta area.

Specimens in the Natural History Museum in London (all checked by PMH) show that the species was present in a range of European locations, including:

Germany, Austria, Hungary, Slovakia, Bohemia, Moravia, N. Italy (Po Valley & Piedmont), and France (Orléans; Vichy; Reims; Hautes-Alpes; Balsièges, Lozère). The records from northern England and Scotland, however, are the most northerly of all the European records reviewed. Indeed, the species appears much more widespread further south, although even here it is considered to be something of a rarity. In the German Red Databook it is listed as vulnerable especially in the Alps and mountains of Baden—Wurttemberg. It has an indeterminate status in Belgium where it is localised in the northern Ardennes and Vlaanderen. Turin (2000) states that the species is not rare in the Netherlands and that it is locally distributed in the few montane regions but more common in the lowlands on large rivers.

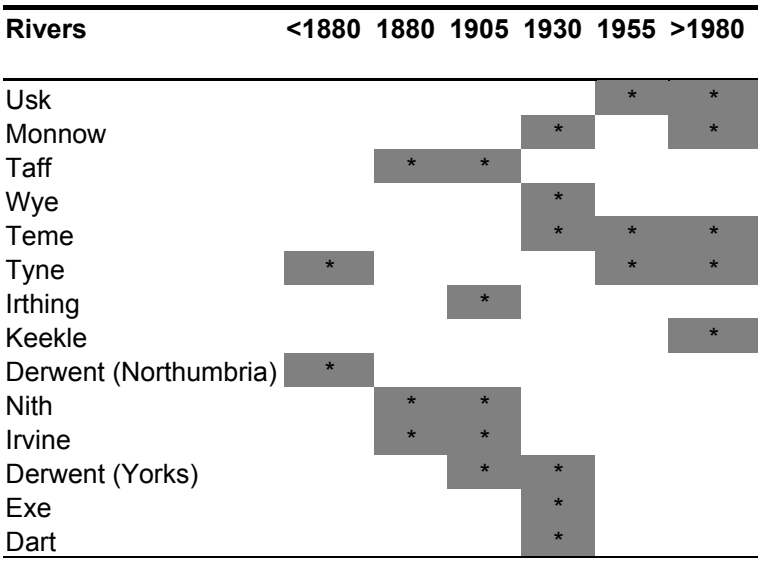

Figure 5: The rivers on which *Bembidion testaceum* has been recorded (Data Source: Table 5)

4.6 Habitat and autecological work

Bembidion testaceum is flighted (macropterous) across all its range and in mainland Europe the species is known to overwinter as a first year imago (Turin, 2000). Some of the specimens captured in this work and those found in an earlier study (Hammond, 2003) were infested with fungal parasites of the order Laboulbenailes. As the parasites require overlapping generations of adults in order to be transmitted, it is clear that the specimens must have overwintered as first year imagines. The larvae have not been described and the larval ecology is unknown.

The species phenology (Figure 6) created using all securely dated records fits this general lifecycle pattern and shows peak abundance of individuals in mid summer, with a reasonable number of individuals still active by September; presumably these are recently emerged adults looking for overwintering sites. Although this matches well with the phenological information in Turin (2000), the Dutch data indicate that the species is actively earlier in the year with peak abundance in May.

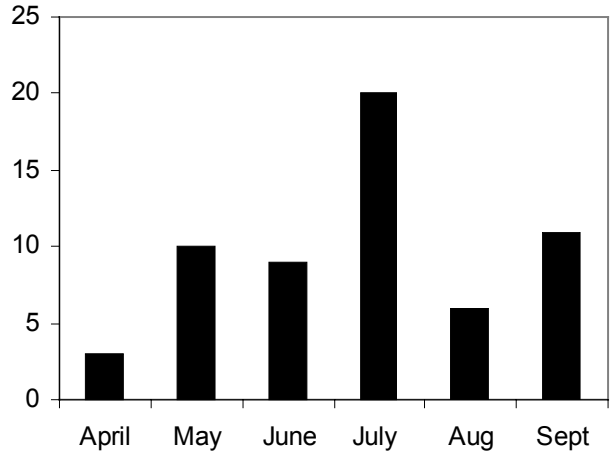

Figure 6: Species phenology (based on all UK records with secure dates)

There are also slight differences in the altitudial range of the species in the UK compared to central Europe. On the continent the species is recorded into the foothills of the Alps, and in Switzerland it is known to range as high as c. 1000m (Turin, 2000). However, in the UK the species has not been recorded over 80m and is it certainly more frequent in the mid to lower reaches of rivers (Figure 7).

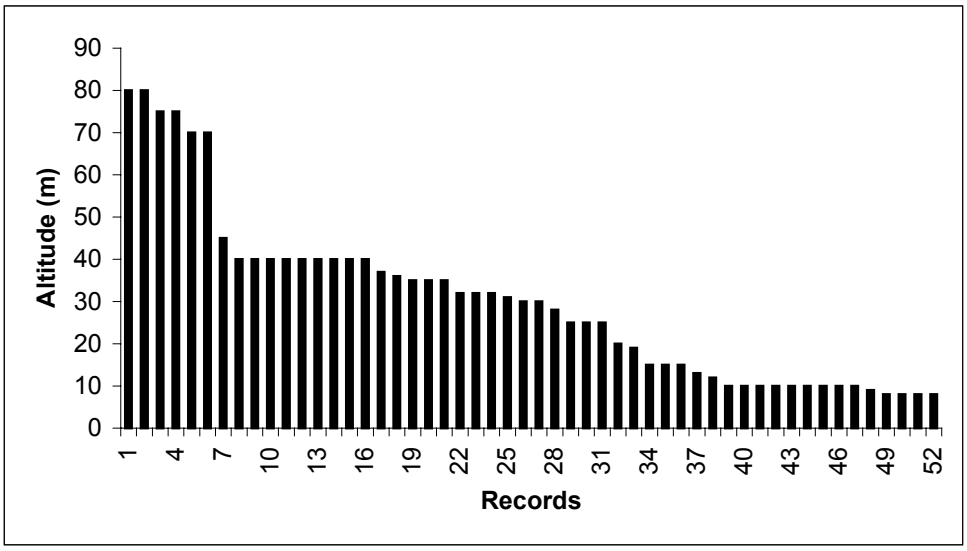

Figure 7: The altitudinal variation of *Bembidion testaceum* in the UK (all data with secure grid references).

4.6.1 Macrohabitat

Lindroth (1974) records *B. testaceum* as a species that frequents the margins of running water, whereas Luff (1998) provides more detail and the BAP records the species as associated with sand and gravel by slow running or standing water (Anon, 1999).

Unfortunately, many of the historical data examined as part of this work provide little guidance as to the exact nature of the habitat in which the specimens were collected. However, the macrohabitats where the species was recorded in the fieldwork appear remarkably variable and range from extremely large and diverse ERS (Figure 8a,b,e), through low-lying, flat and simple ERS (Figure 8f,g,h) to small irregular sediments adjacent to the river banks (Figure 8c, i & j). We also found a large number of specimens at the base of an eroding cliff on the River Usk (Figure 8d). Sediment characteristics were also variable with sediment sizes ranging from boulder and cobble to gravel, although in all instances sand is widespread in the matrix. Detailed Digital Elevation Models (DEMs) created on ERS on the Rivers Tyne, Devil's Water and Usk illustrate this variability very well. The sites on the Usk are large and geomorphologically complex (Figure 9), whereas the ERS on the Tyne and Devil's water had a simple, flattened topography (Figure 10).

On the continent the species has a clear affinity to unshaded, gravelly-sandy edges of waters in the lowlands to foothills (Hurka 1996). Similarly, Turin (2000) suggests that the species is a true riverbank specialist associated with running water and cobbles, pebbles and gravel overlying sands. Hammond (2003) notes that the species is found on slumped sand/clay banks, narrow 'undercliffs' with some shingle at the base and also on consolidated sediments and nearby vegetated areas on the River Loire in France.

A) Usk at Llangibby Bottom A

B) Usk at Llangibby Bottom B

D) Usk Eroding Cliff at Llangibby

C) Usk upstream of Llangibby Bt A

E) River South Tyne at Beltingham

F) River Tyne confluence at Hexham

Figure 8: Macrohabitat associations of specimens of *Bembidion testaceum* recorded as part of the field surveys (Photographs: David Bell)

	
G) Devil's Water	H) River Teme at Shelshey
	
I) River Teme at Stanford Bridge	J) River Monnow at Tregate Bridge

Figure 8 (continued)

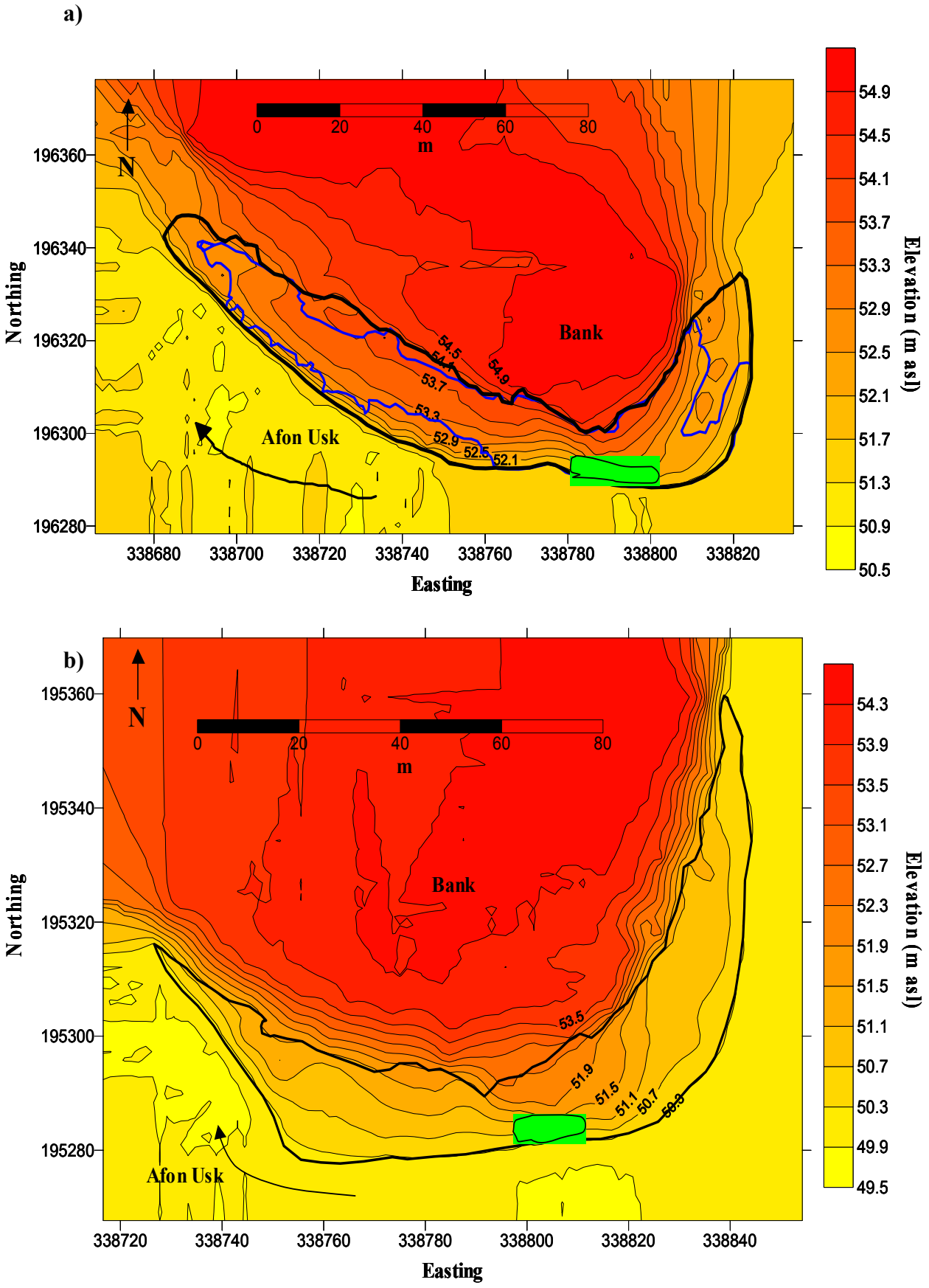

Figure 9: DEMs of the sites at (a) Usk at Llangibby Bottom A and (b) Usk at Llangibby Bottom B. Green shading illustrates the location of the specimens captured and the blue line the extent of vegetation cover.

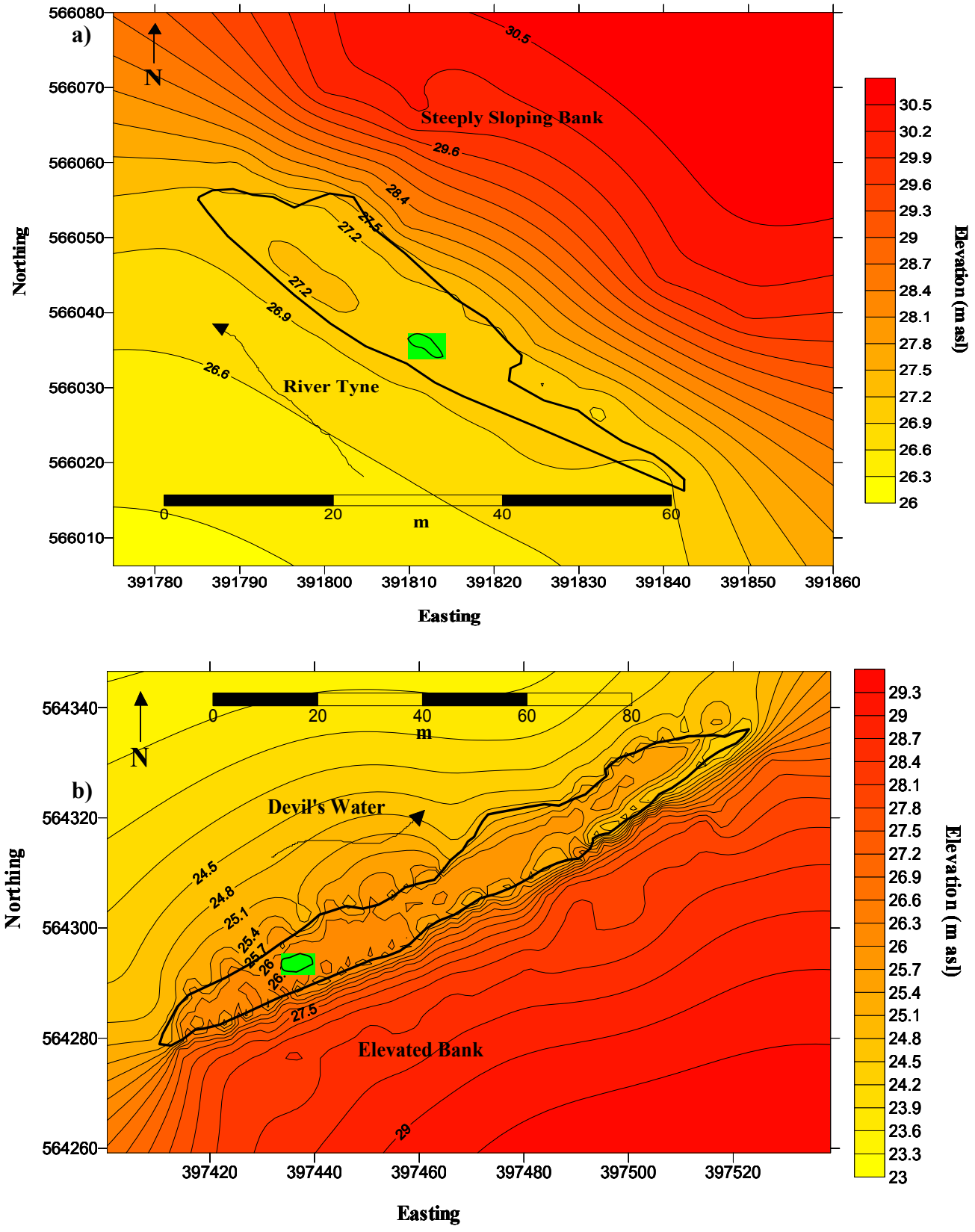

Figure 10: **DEMs of the sites at (a) Hexham on the Tyne and (b) Devil's Water. Green shading illustrates the location of the specimens captured.**

4.6.2 Microhabitat occurrence

The microhabitat affiliations of the species are equally variable, and the captures were extremely localised on each different piece of habitat. On large ERS the species was located low down on the bars, close to the water's edge. In particular, the species was recorded on small 'clifflets' about 40cm high on the Usk (Figure 11c) and about 80cm on the South Tyne (Figure 10b). These 'clifflets' are unconsolidated deposits of mobile sediment that move easily when disturbed. Although normally found within one metre of the water's edge in summer low flow conditions, the specimens from Beltingham on the Tyne were located on a larger 'clifflet' a considerable distance away from water (Figure 11b). However, it should be stressed that sampling at this site took place immediately following after a flood event, when presumably most species had moved away to avoid the rising waters (c.f. Bonn, 2000). Digital elevation models (DEMs) for two sites on the Usk illustrate both the localised nature of the capture points and small-scale topography of the 'clifflets' (Figure 9). Yet on other sites the species was located on unconsolidated gravels, at the bottom of an eroding cliff on the Usk (Figure 11a), and close to the water's edge on simple topography with unconsolidated sediments on the Teme, Monnow and Tyne (Figure 8f-j; 11d; Figure 10), suggesting that it is not exclusively tied to high gradient, crumbling and mobile areas of sediments.

A) Base of eroding Cliff at Llangibby A (Usk)

B) 'Clifflet' at Beltingham (South Tyne)

C) 'Clifflet' at Llangibby A (Usk)

D) River Monnow at Tregate Bridge

Figure 11: Examples of the main microhabitats on which the species was collected (Photographs: David Bell)

	
A) Devil's Water	B) River Tyne confluence at Hexham
	
C) Monnow at Tregate Bridge	D) Usk at Llangibby Bottom A
	
E) Teme at Shelshey Beauchamp	

Figure 12: Examples of the sediment characteristics at the capture sites (Photographs: David Bell)

4.6.3 Sediment affinities

Although clearly complicated, this 'auteocological picture' becomes more consistent if a focus is placed on the characteristics of the exact spot where the specimens were collected. In all instances the beetles were collected on unconsolidated pebbles and / or cobbles overlying clean and coarse sand (never clay) with a little silt in places, although insufficient to make the individual clasts sticky (Figure 12). It would appear that all other recent captures relate to areas with similar sediment characteristics (e.g. Hammond, 2003; Crossley pers. comm.). Interestingly, on many of the sites that were surveyed recently *B. testaceum* co-occurs, although not directly in the same habitat, with *Bembidion littorale*. The latter species is specifically associated with the deposits of fine sands and silts (e.g. Lindroth 1974) that are found at the downstream end of large and diverse ERS. This further confirms the species reliance on sandy sediments.

5. Discussion

5.1 Distribution Pattern

Bembidion testaceum has a northern and western distribution in the UK with a wide range of scattered records from southwest England through Wales into Yorkshire, Northumberland, Cumbria and into southwest Scotland, with only a few localities in the east of the country. The list of known localities, rivers and catchments for which there are confirmed records has been extended by this work. For some localities only very old records are available, whereas for some others there is evidence of current and, apparently, long-standing populations. The most notable points are, perhaps, that *B. testaceum* has been reliably reported in the past from a run of South Wales and Welsh borders rivers (Taff, Usk, Neath, Monnow, Wye, Teme), from a good number of rivers in Southern Scotland, quite widely in Northern England south to Yorkshire, possibly in South Devon or at least one river, and in at least one area further to the southeast (Chobham, Surrey). Although it may have been lost from some of these areas it retains a presence on the Usk, Monnow and Teme (and probably also on the Wye and elsewhere in South Wales/ the border counties), and is still apparently well established in parts of northern England (especially on the Tyne). It is possible that it still occurs fairly widely in Southern Scotland, although it has not been found during recent work on riparian beetle assemblages there (Eyre, 2000).

The continental data show that the species has a strong SE distribution in Europe, ranging though most of Mediterranean and central Europe, although it is absent from Spain and Portugal. It is curious that *B. testaceum* goes so much further north in the western part of its range (i.e. in Britain) and much less so in the east, where it does not extend into Scandinavia. The absence of the species from Fennoscandia is likely to be real, as the riparian fauna there has been so well studied (Andersen & Hanssen, in press). However, this sort of distribution pattern is by no means unique, generally identifying species that are favoured by Atlantic conditions and do not cope well with 'Continental-type' climatic extremes. Indeed, another ERS BAP species, the small hydrophilid *Hydrochus nitidicollis* has a similar pattern, although it is much more restricted to the SW in the UK (Anon, 1999). It seems likely at this larger scale that climate is a primary determinant of the species' distribution rather than anything such as habitat availability, especially as there are very many 'suitable' rivers in southern Sweden and Finland for example.

5.2 Habitat affiliations

At a macro-scale, the species appears to be tied to catchments with hard rock geology that erodes to produce coarse sandy sediments (Table 5). Within this categorisation, the macrohabitat that the species frequented was found to be quite variable. The sites examined during the fieldwork illustrate that the species can be found in a range of sedimentary or morphology units, even anthropogenic habitats such as gravel pits and newly created rivers. This suggests that it is a little more catholic than some other ERS specialists. It could be that catchment hydrology is not a key variable either, as the species

has been recorded from the banks of small to medium rivers with markedly different discharges (Table 7) and standing water in gravel pits. This is in stark contrast to several species of ERS beetles whose distributions are clearly related to the varying hydrological characteristics of river catchments (Sadler et al. 2004).

The key to the distribution of *B. testaceum* probably relates to the microscale habitats and in particular the type of sediment that it requires. The species shows strong affinities to unconsolidated, unvegetated sediment of varying sizes ranging from pebbles to cobbles overlying coarse and clean sands. It is clear also from fieldwork in areas of former records that the species does not enjoy siltation. Sites examined on the Taff, Wye (Hammond 2003), the Derwent (Yorkshire) and in the southwest (Devon) all appear to have undergone an increase in siltation, with sediments characterised by fine brown and sticky deposits that clothe the sand matrix.

5.3 Species ecology

Bembidion testaceum is a predaceous spring breeding species in the UK (Anon 1999) and on the continent (c.f. Turin 2000). The species overwinters as a first year adult and undergoes larval development and pupation through summer, emerging late in summer to find sites for overwintering. Peak abundance in the UK appears to be in mid-summer whereas further east in Europe it peaks in late spring/ early summer. Such a lifecycle pattern is not unusual in riparian specialists (Andersen, 1969), and is an effective means of dealing with life in a system prone to seasonally driven disturbance events (Plachter & Reich, 1998). The species is macropterous across all of its range and although records of flight activity are not well documented, Turin (2000) notes that it is consistently long-winged and has full flight musculature. We can confirm that during our survey work *B. testaceum* was one of the most active of the *Bembidion* species encountered and that it readily 'took to the wing' when disturbed.

However, flight capability is not uncommon in riparian beetles. Desender (1989) records high levels of macroptery in riparian beetle species, a useful trait in an environment where inundation is a sporadic and unpredictable event. Indeed, the proportion of macropterous beetles on unvegetated ERS varies in relation to ERS location in the floodplain. Close to the river edge, between 91-99% of the species are capable of flight and this proportion falls to about 76% on individual habitat patches that are rarely inundated (Plachter, 1986). Bonn (2000), in a study of the River Elbe in northern Germany, demonstrated that carabids fly actively after the spring and autumn floods - normally towards the river, and presumably in search of newly deposited food resources, and also that species appear to move away from the river immediately before flood peaks.

5.4 Species populations

Although records indicate a consistent presence on some rivers, suggesting some population resilience and persistence, *B. testaceum* always was found in low densities on the ERS habitats surveyed in the project. Indeed, in all the survey effort during the last 2 years the maximum number of specimens

collected in any one sample was 13 and on most occasions only 1-3 individuals were captured despite many hours of sampling (Appendix A & B). This stands in stark contrast to other, more common gravel specialists, such as *Bembidium atrocoeruleum*, which has been found in densities averaging 22/m^2 on the river Seven in Wales using identical sampling techniques (Sadler *et al*. unpubl.). In part, this difference clearly reflects the time of year of the sampling and the weather conditions at the time of the sample. However, the weather was fine on some field days and sample effort was also high on many of the sites. It is tempting, therefore, to see this as a real element of the population dynamics of the species.

Table 6: Hydrological information relating to the rivers sampled during the survey

River	CEH Station Number	Station Name	Grid Reference	Period of record	Q95 (m^3s^{-1})	Mean Flow (m^3s^{-1})	Base Flow Index	Median Annual Flood (m^3s^{-1})	Catchment Area (km^2)
Usk (Wales)	056001	Chain Bridge	SO 345056	1957-2000	4.11	28.34	0.52	379.7	911.7
Monnow (Wales)	055029	Grosmont	SO 415249	1948-2000	0.67	6.04	0.51	131.4	354.0
Taff (Wales)	057005	Pontypridd	ST 079897	1970-2000	3.59	19.86	0.47	288.9	454.8
Wye (Wales)	055023	Redbrook	SO 528110	1936-2000	11.54	74.06	0.54	512.6	4010.0
Teme (Midlands)	054029	Knightsford Br	SO 735557	1970-2000	1.92	17.7	0.55	183.3	1480.0
Tyne (North East)	023001	Bywell	NZ 038617	1956-2000	5.99	45.06	0.38	883.6	2175.6
Irthing (North West)	076008	Greenholme	NY 486581	1967-2000	1.02	7.5	0.32	194.3	334.6
Northumbria Derwent (North East)	023007	Rowlands Gill	NZ 168581	1962-2000	0.81	2.55	0.57	38.2	242.1
Yorkshire Derwent (North East)	027041	Buttercrambe	SE 731587	1973-2000	3.9	16.21	0.68	82.0	1586.0
Keekle	744250	St Leonards	NY 0130413523	1996-1998	0.076	0.73	No data	No data	33*
Exe (South West)	045001	Thorverton	SS 936016	1956-2000	1.95	16.19	0.50	175.3	600.9
Dart (South West)	046003	Austins Bridge	SX 751659	1958-2000	1.49	11.23	0.52	213.1	247.6
Irvine (Scotland)	083005	Shewalton	NS 345369	1972-2000	0.50	9.71	0.27	215.3	380.7
Nith (Scotland)	079002	Friars Carse	NX 923851	1957-2000	2.77	27.38	0.39	454.0	799.0

The highly dynamic nature of ERS environments suggests a high turnover of habitat patches. Recent work on the Tagliamento River in Italy illustrates that under natural conditions floodplain habitats are extremely dynamic, even over short timescales (van der Nat *et al.*, 2003), but the configuration and area of habitats remains relatively stable (Arscott *et al.*, 2002), providing a continuity of habitats which are available for colonisation.

The high turnover of ERS habitats necessitates the transfer of some individuals between habitat patches, so it is unlikely that populations of ERS specialists exist as 'separate' populations. Population types range from those that function as 'sources' or 'sinks' (Pulliam, 1988; Pulliam & Danielson, 1991; Watkinson & Sutherland, 1995), all of which may exist as 'metapopulations' or as single 'patchy' populations (Harrison, 1991). The dispersal attributes and low abundance of *Bembidion testaceum* is suggestive of a patchily distributed population and this further reinforces the links between patch creation and destruction. It is essential therefore that the hydrological dynamics of the catchments in which the species is found are not changed in any significant manner, although one must acknowledge that natural hydrological variation may occur in relation to climate fluctuations.

5.5 Evidence for decline

Although care must be taken not to read too much into absence data, the species now appears to occupy fewer river catchments than it did in the past (Figure 5). A considerable amount of field effort has been expended in looking for this and other species associated with ERS within the UK during the last 10 years. One might, therefore, cautiously accept that some of the absences highlighted in this study are real or, if not, indicate very low population levels. For example, the records on the River Taff around the turn of the twentieth century indicate a thriving population around Llandaff and, although details of the capture sites are not available, the specimens are good. The areas around Cardiff in grid squares ST17 and ST18 have been surveyed extensively during the last two years without success (cf. Hammond, 2003), suggesting that it is not currently on this stretch of the Taff, or is present in such low numbers as to be extremely difficult to find.

It is possible to postulate that a similar situation exists on the rivers in Devon, where there are three historical records. Since 1998 there have been seven separate studies examining SW rivers using a full range of sample techniques (Bell & Sadler, 2002, 2003b, c; Bell *et al.*, 2004; Hammond, 1998a; Sadler & Bell, 2000) and the species has not been recorded although we have not examined any sites this far down the systems towards the tidal limit. Likewise, the species has a number of historical records from the Cumbrian rivers and despite extensive sampling in 1999 (Hewitt *et al.*, 2000) of the catchment of the River Eden and subsequent work on the Eden and Derwent catchments over the past four years (Hewitt *et al.*, 2005), the species seems stubbornly absent there also, although it has clearly arrived in the Keekle catchment from somewhere.

Dalglish's records from the Irvine coupled with Sharp's captures from the Nith catchment and Holland's work around Glasgow show the potential for the

species in SW Scotland. Although, this area was not sampled during this project, Dr M.D. Eyre carried out a substantial amount of work on some of these rivers, especially the Nith, during 1996-7 (Eyre, 2000). These studies, however, have centred on pitfall-trapping and have emphasised the upper parts of bars. There is no evidence that *B. testaceum* is at all readily captured by pitfall-trapping or is at all active at any distance from the water's edge.

A considerable amount of ERS survey has been undertaken on the Wye also, although recently most of this has focused on the stretch of river upstream from Hay-on-Wye (the site of one of Tottenham's early records). Unfortunately, we were not able to survey the area around Symond's Yat (the site of Tottenham's other Wye record), although Hammond searched for *Bembidion testaceum* in this area in 2003 without success (Hammond 2003).

One must conclude, therefore, that the species has undergone a recent reduction in its range within the UK, although it retains a stronghold on a number of rivers in Wales and northern England and possibly SW Scotland. This information, coupled with the fact that the species has recent records from only 7 10km squares in the UK, strongly suggests that its conservation status warrants redesignation from Nb to RDB2.

5.6 Reasons for decline

A range of different factors have been postulated as threats to populations of the river shingle specialists beetles on the UK grouped species action BAP that includes *Bembidion testaceum*. These include (Anon 1999):

1. Water level regulation by damming and flood alleviation schemes.

2. Water abstraction.

3. Agricultural improvement resulting in drainage and nutrient enrichment.

4. Land use changes and development (e.g. urban) that impinge on riparian habitats.

5. River engineering such as dredging, straightening or grading of riverbanks.

6. Livestock encroachment on riverside shingle and other riverbank features.

7. Colonisation of riverbanks by Himalayan Balsam, *Impatiens glandulifera* and other invasive plant species.

These factors act at a range of different scales. Factors 1-4 are operative at a larger scale and one must focus upon catchment scale changes to establish their applicability to *B. testaceum*. With a limited pool of data it is difficult to assess unequivocally the relative effects of catchment changes on *Bembidion testaceum*. However, strong empirical data exist indicating that river regulation affects channel form and sedimentation as a result of changes in the magnitude and frequency of flooding events (Petts, 1984, 1988; Petts & Pratts, 1983). This has major impacts on both the in-stream fauna (Greenwood *et al.*, 1999; Petts, 2000) and implications for the dynamics of riparian species. For example,

studies have shown that river regulation and flood defence schemes can result in variations of the hydrological regime leading to vegetation colonization (Gilvear *et al.*, 2000; Parsons & Gilvear, 2002). The resulting stabilisation of the sediments is a source of real concern to conservationists and river catchment managers (Hammond, 1998b). Moreover, recent work by Brewer et al. (2001) has shown that during the last 50 years the amount of ERS on Welsh rivers has reduced significantly as a result of changes in the frequency and magnitude of flooding. Although not well documented, these activities may have an impact on ERS invertebrate communities, which rely on expanses of mobile, sorted and bare sediments as habitat. On the river Isar in Germany, reservoir construction distinctly altered the carabid community of the lower floodplain, suggesting that sediment transport during extreme flooding events was an important factor structuring ERS and hence the invertebrates there. Recent work illustrates that flow regulation can affect ERS communities by increasing bar stability and enhancing vegetation succession (Niemeier *et al.*, 1997). It is quite clear that when catchment hydrology is modified by either regulation schemes or engineering aimed at reducing the instances of flooding and/or bank erosion, the shingle bars become less common and those that persist become more stable and undergo vegetation succession (Sadler et al. 2004).

Given that records of *Bembidion testaceum* exist from slow-flowing and standing water, it is tempting to suggest that the species is not likely to be affected adversely by river regulation. However, all recent records are from rivers that have similar hydrological attributes such as flashy hydrographs and rapid flow variations in relation to precipitation events. These characteristics are the engine that creates physical habitat variability in ERS systems. It seems likely that the records from standing waters (Farnham gravel pits) and the newly constructed stretch of the Keekle in Cumbria are atypical and that they result from a substitution of these 'natural' hydrological variables with anthroprogenic ones, which just happen to have created the microhabitats that the species requires. If this is the case, then the outlook for the species in these areas is bleak as after the initial disturbance event the sediments will stabilise and vegetate very quickly. Indeed, a resurvey of the Farnham gravel pits showed that there is no suitable habitat left there at the present time.

River engineering such as the use of weirs to modify flow, bank protection to reduce erosion and embankment for flood protection are clearly capable of impacting *Bembidion testaceum* populations. Indeed, on a number of rivers, such as reaches of the lower Tyne, the Northumbrian Derwent, the Yorkshire Derwent and the Taff around Cardiff, its disappearance might be best explained by habitat loss occasioned by large scale river engineering and embankment associated with urbanisation or flood defence. This has drastically reduced the available habitat and in large stretches of these rivers (Appendice A & B). A similar situation occurs on the River Dart in Devon where there is very little evident ERS habitat in the catchment, especially around Totnes, which is the site of Massey's specimen. Elsewhere in Devon the apparent absence of the species seems real enough, although perhaps more difficult to explain. Surveys of both the Rivers Exe and Teign have confirmed the presence of a large and impressive suite of ERS Coleoptera including the BAP species, *Perileptus areolatus* and *Hydrochus nitidicollis* (Hammond 1998a; Sadler and Bell, 2000; Bell et al. 2004) and there certainly seems to be a wealth of suitable ERS habitat remaining on these rivers and many others in Devon and Cornwall, but

not around sections near the tidal limit of the Rivers Teign (near Teignmouth), Exe (near Exmouth) and the Dart (at Totnes) where all the early Devon records originate. Perhaps significantly, further upstream the Teign and Exe are noticeably silt enriched and eutrophic as a result of changing land use, in particular increased stocking densities and conversion of permanent pasture. Thus to account for the species absence here one is left with the speculation that it could be siltation that is causing the problem. Interestingly, the few remaining patches of 'suitable' ERS habitat on the River Taff in Wales were silt impregnated. For species like *Bembidion testaceum*, which exists in small populations and has quite specific habitat requirements, the cumulative effect of such apparently small engineering operations could remove populations directly.

A factor of some concern is the density and impact of livestock on riparian habitats. Not only do livestock (particularly cattle) cause significant modification to geomorphological processes such as stabilisation and erosion (Trimble & Mendel, 1995), but they tend to cause direct damage to riparian margins and affect habitat structure and diversity (Jansen & Robertson, 2001). The presence of livestock is particularly important on lowland ERS in England and Wales as many large ERS rivers are heavily stocked, particularly in parts of Wales and in Devon and Cornwall. It is possible that livestock can have a serious affect on some orders of ERS invertebrates by compacting the substrate and destroying habitat and possibly refuge sites that might be used for over-wintering, especially for those that utilise interstitial habitats. Indeed, trampling was shown to effect species richness and rarity of ERS beetles assemblages (Sadler et. al. 2004), but until recently little was known concerning its impact on individual species populations. Work on populations of *Bembidion atrocoeruleum* on the River Severn in Wales has indicated that populations are much reduced on ERS that are subjected to poaching by cattle and sheep (Bates et al. submitted). However, Hammond (2003) notes that the sites where *B. testaceum* was found on the River Usk were poached by cattle, a situation that was replicated during this work. However, given the small scale nature of populations of this species one cannot conclude with any degree of certainty that trampling is <u>not</u> a threat, especially where stocking levels are very high. Additionally, livestock defecation, although it does enhance siltation directly could lead indirectly to an increase in organic sedimentation resulting from a general eutrophication of the river. This could lead to an increase in the rate of vegetation development and subsequent stabilisation of the sediments.

5.7 Identification and related fieldwork Issues

Two main factors have affected the outcomes of the fieldwork in this study. First the species is very difficult to find in the field and a lot of hand searching was required before the first specimen was located (Appendices A & B). However, once the 'eye is trained' to finding the appropriate sedimentary characteristics (section 4.6.3) the job becomes considerably easier. Nonetheless, the species occurs only in very low abundances. This problem is exacerbated also by the fact that *B. testaceum* is very difficult to identify in the field as the only reliable characteristics that differentiate it from other species of *Bembidion* require higher levels of magnification and better lighting conditions than those available when using a field (hand) lens. *Bembidion testaceum* is often found in association with a number of maculate *Bembidion,* mostly of the

subgenus *Peryphus*, which can easily lead to confusion and misidentification. In this survey work the species was found along side *Bembidion tetracolum*, *B. fluviatile*, *B. femoratum* and *B. decorum* (Appendices A & B). As Hammond (2003) noted probably the best reliable characters that might be used to identify live specimens is the colour and nature of the maculae, which are more testaceous (yellowish) in *B. tetracolum*, and *B. femoratum* (and many other maculate species of the subgenus, including *B. bruxellense* and *B. andreae*). The maculae in *B. testaceum* are more reddish and less clearly defined. In this respect it is very close to *B. fluviatile*, although this species is considerably larger and has longer more slender legs. Both of these species were found to co-occur on an eroding cliff on the River Usk, although we are not aware of their co-occurrence on ERS in the true sense. The situation is further complicated by the occurrence of 'rufinistic' individuals of *Bembidion decorum*, which have their otherwise bluish black elytra suffused with a reddish colour. Although the presence of minute punctures around the eyes of *B. decorum* (which are visible using a hand lens) should help sort out this problem, all our specimens of *B. testaceum* had vestigial punctures that look superficially similar.

Secure identifications, therefore, require comparisons with confirmed specimens in well-curated museum and/or personal collections. Even in this case, however, errors can still be made. A number of the specimens recorded in the museum collections were standing as *B. tetracolum* or were un-named (Table 2) and several specimens in the National Museum of Cardiff were misidentified as *B. andreae*, *B. bruxellense*, *B. femoratum* and *B. tetracolum* (Hammond, 2003).

6.Conclusions

Although not without limitations, this project has provided a thorough review of the distribution and ecology of *Bembidion testaceum*. As a result we can make the following conclusions:

1. This work has shown that *Bembidion testaceum* is an elusive species that has sporadic distribution in the UK. Moreover, it occurred in very low numbers and was extremely difficult to find in the field, requiring a large investment of 'field time' and an appreciable amount of 'field experience'.

2. Despite the creation and isolation of a number of new records as a result of both the museum and fieldwork, it is clear that *Bembidion testaceum* has a very limited UK distribution. Extant populations of the species are known only from the Rivers Usk and Monnow in Wales, the Teme on the Welsh Borders, and Tyne in northern England. There is also an additional single record from the River Keekle in west Cumbria.

3. The species was formerly more widespread in the UK and has undergone a reduction in its range during the last 50 – 100 years. The reasons for this are not especially clear, but related (in some cases) to habitat loss occasioned by river engineering and possibly siltation.

4. It is not possible to discount the possibility that the species might also be found on other Welsh rivers, such as the Wye and on the rivers in SW Scotland, where survey work was more restricted in nature.

5. Its current status as Nb is in error and grossly underestimates the species' true conservation worth.

6. Although the species appears a little more catholic in terms of its macrohabitat associations, it is very 'fussy' in terms of its microhabitat and was found only on unconsolidated cobble-pebbles overlying clean and coarse sands.

6.1 Recommendations

1. There remains some scope for further field survey work especially on the rivers in southwest Scotland and the River Wye in Wales, where the species was formerly widely distributed and little appropriate field effort has been expended.

2. It is essential that further detailed autecological work be undertaken to improve our understanding of the species habitat requirements and life cycle. However, its limited distribution, coupled to its low abundances militates against field studies, a situation exacerbated by the fact that the species is also difficult to find and identify in the field. This work is best suited to laboratory studies.

3. The species designation should be changed to RDB2 to reflect better its current status and apparent decline.

4. River management on rivers with extant populations should be thoroughly evaluated. The following engineering works should be avoided: damming, impoundment, embankments, revetment (and other flood defence techniques that effect riverbanks) and weirs.

5. Catchment management plans should consider the implications of land use changes (e.g. increases in hard surfaces, stocking densities and so on) and the effect these may have on river sedimentation and nutrient enrichment.

6. Although it is clear that the species can tolerate low levels of trampling (especially on large ERS), where this may help maintain bare ground habitat, heavy trampling will have a deleterious impact on the sediments, causing compaction and possibly additional siltation via enhanced erosion. In instances such as these it may be necessary to restrict stock access to the riparian margin.

7. References

Andersen, J. (1969) Habitat choice and life history of *Bembidion* (Col., Carabidae) on river banks in central and northern Norway. *Norsk Entomologisk Tidsskrift*, **17**, 17-65.

Andersen, J. (1978) The influence of substratum on the habitat selection of Bembidiini (Col., Carabidae). *Norwegian Journal of Entomology*, **25**, 119-138.

Andersen, J. (1983) The life cycles of the riparian species of *Coleoptera*, Carabidae) in northern Norway. *Notulae Entomologicae*, **63**, 195-202.

Andersen, J. & Hanssen, O. (in press) Riparian beetles, a unique, but vulnerable element of the fauna of Fennoscandia. *Biodiversity and Conservation*.

Anon (1999). UK Biodiversity Group Trache 2 Action Plans. English Nature, Peterborough.

Arscott, D.B., Tockner, K., van der Nat, D., & Ward, J.V. (2002) Aquatic habitat dynamics along a braided alpine river ecosystem (Tagliamento River, Northeast Italy). *Ecosystems*, **5**, 802-814.

Ball, S.G. (1994) The invertebrate site register - objectives and achievements. *British Journal of Entomology and Natural History*, **7 (Suppl. 1)**, 2-14.

Bates, A.J., Sadler, J.P., Fowles, A.P., & Butcher, C.R. (in press) Spatial dynamics of beetles living on exposed riverine sediments in the Upper River Severn: Method development and preliminary results. *Aquatic conservation - Marine and Freshwater Ecosystems*.

Bell, D. & Sadler, J.P. (2002). The invertebrate fauna (Coleoptera and Araneae) of exposed riverine sediments in Cornwall and West Devon: A survey report. Environment Agency, SW Region.

Bell, D. & Sadler, J.P. (2003a). The Coleopteran fauna of exposed riverine sediments on the river Dane, Cheshire: A survey report. Enivornment Agency, NW region.

Bell, D. & Sadler, J.P. (2003b). The Coleopteran fauna of five exposed riverine sediment sites in Cornwall and West Devon: A survey report. Environment Agency, SW Region.

Bell, D. & Sadler, J.P. (2003c) The invertebrate fauna (Coleoptera and Araneae) of coastal shingle as Loe Bar, Cornwall: A survey report. Environment Agency, SW region.

Bell, D., Sadler, J.P., & Drake, C.M. (2004). The invertebrate fauna of exposed riverine sediments in Devon: a survey report, Environment Agency, SW Region.

Bonn, A. (2000). Flight activity of carabid beetles on a river margin in relation to fluctuating water levels. In *Natural History and Applied Ecology of Carabid Beetles* (eds P. Brandmayr, G.L. Lövei, T.Z. Brandmayr, A. Casale & A.V. Taglianti), pp. 147-160. Pensoft, Sofia.

Brewer, P.A., Maas, G.S., & Macklin, M.G. (2001). A fifty-year history of exposed riverine sediment dynamics on Welsh rivers. In *Water in the Celtic world: managing resources for the 21st century*, pp. 245-252. British Hydrological Society, Occ. paper No. 11.

Eyre, M.D. (2000). Preliminary assessment of the invertebrate fauna of exposed riverine sediments in Scotland. Scottish Natural Heritage Commissioned Report F97AC306 (unpubl. report).

Eyre, M.D. & Lott, D.A. (1997) *Invertebrates of Exposed Riverine Sediments* R & D Technical Report W11. Environment Agency, Bristol.

Eyre, M.D., Lott, D.A., & Luff, M.L. (2001a) The rove beetles (*Coleoptera, Staphylinidae*) of exposed riverine sediments in Scotland and northern England: Habitat classification and conservation aspects. *Journal of Insect Conservation*, **5**, 173-186.

Eyre, M.D., Luff, M.L., & Lott, D.A. (2000) Records of rare and notable beetle species from riverine sediments in Scotland and northern England. *The Coleopterist*, **9**, 25-38.

Eyre, M.D., Luff, M.L., & Phillips, D.A. (2001b) The ground beetles (Coleoptera : Carabidae) of exposed riverine sediments in Scotland and northern England. *Biodiversity and Conservation*, **10**, 403-426.

Fowles, A.P. (1989) The Coleoptera of shingle banks on the River Ystwyth, Dyfed. *Entomologist's Record*, **101**, 209-221.

Fox, P.J.A., Naura, M., & Scarlett, P. (1998) An account of the derivation and testing of a standard field method, River Habitat Survey. *Aquatic Conservation-Marine and Freshwater Ecosystems*, **8**, 455-475.

Gilvear, D.J., Cecil, J., & Parsons, H. (2000) Channel change and vegetation diversity on a low-angle alluvial fan, River Feshie, Scotland. *Aquatic Conservation-Marine and Freshwater Ecosystems*, **10**, 53-71.

Greenwood, M.T., Bickerton, M.A., Gurnell, A.M., & Petts, G.E. (1999) Channel changes and invertebrate faunas below Nant-y-Moch dam, River Rheidol, Wales, UK: 35 Years on. *Regulated Rivers-Research & Management*, **15**, 99-112.

Hammond, P. (1998a) *Survey of the invertebrates on Exposed Riverine Sediments on the Rivers Teign and Bovey near their confluence* Unpublished Report, Environment Agency, Devon Area.

Hammond, P.M. (1998b). Riparian and floodplain arthropod assesmblages: their characteristics and rapid assessment. In *United Kingdom floodplains* (eds R.G. Bailey, P.V. Jos, & B.R. Sherwod), pp. 237-282. Westbury Press, Otley.

Hammond, P.M. (2003). Preliminary survey for the ground beetle *Bembidion testaceum* on the River Usk. CCW Contract Science No. 608., CCW, Bangor.

Harrison, S. (1991) Local Extinction in a Metapopulation Context - an Empirical-Evaluation. *Biological Journal of the Linnean Society*, **42**, 73-88.

Hewitt, S.M., Atty, D.B., Parker, J., Read, J., & Sinclair, M. (2005). Survey of insects of exposed riverine sediments on the rivers Eden and Derwent in Cumbria in 2004. Report to the Environment Agency and English Nature.

Hewitt, S.M., Atty, D.B., Parker, J.B., & Sinclair, M. (2000). Cumbrian River Shingle Invertebrates Survey. Unpubl. report, Carlise Natural History Society, Carlise.

Horion, A. (1941) *Faunistik der mitteleuropäischen Käfer, Band 1.* Goecke & Evers, Krefeld.

Hyman, P.S. (1992) *(Updated by MS Parsons) A Review of the Scarce and Threatened Coleoptera of Great Britain. Part 1* JNCC, Peterborough.

Jansen, A. & Robertson, A.I. (2001) Relationships between livestock management and the ecological condition of riparian habitats along an Australian floodplain river. *Journal of Applied Ecology*, **38**, 63-75.

Jeannel, R. (1942) *Coléoptères Carabiques II*.

Lucht, W.H. (1987) *Die Kafer Mitteleuropas* Goecke and Evers, Krefeld.

Luff, M.L. (1998) *Provisional atlas of the ground beetles (Coleoptera, Carabidae) of Britain* Biological Records Centre, Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton.

Niemeier, S., Reich, M., & Plachter, H. (1997) Ground Beetles Communities (Coleoptera: Carabidae) on the banks of two Rivers in the Eastern Carpathians, the Ukraine. *Verhandlungen der Gesellschaft für Ökologie*, **27**, 365-372.

Parsons, H. & Gilvear, D. (2002) Valley floor landscape change following almost 100 years of flood embankment abandonment on a wandering gravel-bed river. *River Research and Applications*, **18**, 461-479.

Petts, G.E. (1984) Sedimentation within a regulated river. *Earth Surface Processes and Landforms*, **9**, 125-134.

Petts, G.E. (1988) Accumulation of fine sediments within substrate gravels along two regulated rivers, UK. *Regulated Rivers: Research and Management*, **2**, 141-153.

Petts, G.E. (2000) A perspective on the abiotic processes sustaining the ecological integrity of running waters. *Hydrobiologia*, **422**, 15-27.

Petts, G.E. & Pratts, J.D. (1983) Channel changes following reservoir construction on a lowland English River. *Catena*, **10**, 77-85.

Plachter, H. (1986). Composition of the carabid beetle fauna of natural riverbanks and of man-made secondary habitats. In *Carabid Dynamics: Their Adaptations and Dynamics* (eds P.J. den Boer, M.L. Luff, D. Mossakowski & F. Weber), pp. 509-535. Gustav Fisher, Stuttgart.

Plachter, H. & Reich, M. (1998) The significance of disturbance for population and ecosystems in natural floodplains. In The International Symposium on River Restoration, pp. 29-38, Tokyo.

Pulliam, H.R. (1988) Sources, Sinks, and Population Regulation. *American Naturalist*, **132**, 652-661.

Pulliam, H.R. & Danielson, B.J. (1991) Sources, Sinks, and Habitat Selection - a Landscape Perspective on Population-Dynamics. *American Naturalist*, **137**, S50-S66.

Raven, P.J., Holmes, N.T.H., Dawson, F.H., & Everard, M. (1998) Quality assessment using River Habitat Survey data. *Aquatic Conservation-Marine and Freshwater Ecosystems*, **8**, 477-499.

Sadler, J.P. & Bell, D. (2000) *A comparative site assessment of exposed riverine (ERS) beetles in South-West England* English Nature Research Reports, No. 383, Peterborough.

Sadler, J.P. & Bell, D. (2002) *Invertebrates of Exposed Riverine Sediments - Phase 3 - Baseline communities*, Bristol.

Sadler, J.P., Bell, D., & Fowles, A.P. (2004) The hydroecological controls and conservation value of beetles on exposed riverine sediments in England and Wales. *Biological Conservation*, **118**, 41-56.

Sadler, J.P. & Petts, G.E. (2000) *Invertebrates of Exposed Riverine Sediments - Phase 2. Sampling considerations* Environmment Agency, Bristol.

Trimble, S.W. & Mendel, A.C. (1995) The cow as a geomorphic agent - a critical review. *Geomorphology*, **13**, 223-253.

Turin, H. (2000) *De Nederlandse loopevers, verspreiding en oecologie (Coleoptera: Carabidae)*, Leiden.

van der Nat, D., Tockner, K., Edwards, P.J., Ward, J.V., & Gurnell, A.M. (2003) Habitat change in braided flood plains (Tagliamento, NE-Italy). *Freshwater Biology*, **48**, 1799-1812.

Ward, J.V., Tockner, K., & Schiemer, F. (1999) Biodiversity of floodplain river ecosystems: Ecotones and connectivity. *Regulated Rivers-Research & Management*, **15**, 125-139.

Watkinson, A.R. & Sutherland, W.J. (1995) Sources, Sinks and Pseudo-Sinks. *Journal of Animal Ecology*, **64**, 126-130.

Appendix A

Bembidion testaceum project – Fieldwork Diary 2004

Cardiff area 1-2/6/04

Staff – Peter Hammond

1 June 2004
Walked the Taff banks between ST176767 and ST151787, and checked all bars of any size. Took hand collected/ washing banks samples at 5 sites, and a flood debris sample at one site. Photographs taken of bars and other features. Only one bar sampled (Site 1) was of any great extent, with some 10 metres of open ground between the water's edge at the time and the more or less vertical river banks. All parts of the river seen are embanked or, if the banks appear 'natural', these are generally vertical and levees are present well back from the bank. Water levels below the weirs were low at the time of visit, but highish, with no bars visible, for at least several hundred metres above each weir. All bars, with the exception of the complex of bars, several of them isolated in mid-stream, below Llandaff Weir, were very flat. All would be well under water during winter high water. The river in the vicinity of the big bend (ca ST169782) above the Gabalfa Weir has steep well vegetated banks, mostly covered with Japanese knotweed, and no bars. I had been keen to examine this area, thinking that a large point bar here may have been the original Llandaff *B. testaceum* site but, if there was once a bar here, it is now well buried or washed away. An alternative site where *B. testaceum* may have been found in the past is the smaller bend (ca ST154783) below the Llandaff Weir (see 2/6/04).

2 June 2004
Cycled both left and right banks of the Taff between ST148788 and ST172777. Took hand collected/ washing banks samples at two further sites, a flood debris sample at one further site, and further photographs. Immediately below the Llandaff Weir, there is a complex of cobble/ shingle bars. All of the more readily accessible parts of this complex were sampled, as was the point bar at ca ST155784.

Cycled the banks of the River Ely between ST114768 and ST145768, and took samples from small bars between ST117768 and ST122772. Only one small gravel bar seen (not sampled – wrong side of the river) at ca ST130771. Otherwise the banks of the river are mostly vertical clay/sand banks, with only occasional small slumped areas of bare sand/clay.

These lowest (but non-tidal) stretches of the Taff investigated on this visit are not too dissimilar from the stretches looked at in 2003 (Hammond, 2003). There are few bars, and most of these seem to be of fairly recent origin (e.g. just below bridges and weirs). Although the upper part of the bars investigated was composed of sand/clay, the rather flat areas of cobbles below were rather 'mucky'. Wherever the old Llandaff site was, I imagine that it is now very different! I still envisage this as being possibly on the big bend above the

'Gabalfa' weir, where the river bank on both sides is now wooded and steep-sided. At one time there should have been a decent-sized point bar there backed up by clay/sand banks. Nowhere is there now any 'natural' riverbank that has slumped.

Coleoptera species in flood debris samples from the Taff, 1-2 June 2004

Large piles of debris in various places. Samples taken from (1) right bank just above Site 1a, and (2) from left bank below Gabalfa Weir.

	1	2
Bembidion harpaloides	++	+
Pterostichus strenuus	+	-
Agonum assimile	+	-
Dromius melanocephalus	+	-
Ptenidium longicorne	+	+
Acrotrichis sp.	+	+
Anthobium unicolor	+	-
Lesteva heeri	++	++
Ochthephilus aureus	+	-
Anotylus rugosus	-	+
Anotylus sculpturatus	-	+
Rugilus rufipes	+	-
Gabrius breviventer	-	+
Quedius umbrinus	+	+
Habrocerus capillaricornis	+	+
Sepedophilus constans	+	+
Sepedophilus littoreus	+	+
Sepedophilus marshami	+	+
Atheta clientula	+	-
Atheta fungi	+	+
Chiloporata longitarsis	-	+
Bryaxis curtisi	+	-
Trixagus dermestoides	-	+
Otiorhynchus singularis	+	-
Barypeithes araneiformis	-	+
Barypeithes pellucidus	++	++

Coleoptera species in hand collecting/ washing samples from the Taff and Ely, 1-2 June 2004.

Site 1: right bank of Taff, ST175771. Largeish bar. Sampled, photographed.
Site 1a: right bank of Taff, ST174772. Narrow bar just upstream from Site 1. Sampled, photographed.

Site 2: right bank of Taff, ST171780. Series of small bars below Gabalfa Weir. Sampled, photographed.
Site 3: left bank of Taff, ST162782. Small bar immediately below Gabalfa Bridge. Sampled, photographed.
Site 4: right bank of Taff, ST155784. Reasonable size point bar. Sampled, photographed.
Site 5: left bank of Taff, ST152785. Small bar below Llandaff Weir. Sampled, photographed.
Site 6: right bank of Taff, ST153783. Complex of bars below Llandaff Weir, some flat, others with steeper sides. Sampled, photographed.
Site 7: left bank of Ely, ST117768 to ST122772, small sand/clay bars. Sampled.

++ = present in some numbers

	1	1a	2	3	4	5	6	7
Clivina collaris	-	-	-	-	+	-	-	-
Bembidion properans	-	-	-	-	-	-	-	+
Bembidion punctulatum	++	-	++	++	++	-	++	-
Bembidion dentellum	-	-	-	-	-	-	-	+
Bembidion varium	-	-	-	+	-	-	-	+
Bembidion prasinum	++	+	++	+	+	-	++	-
Bembidion atrocoeruleum	++	-	-	-	++	+	++	-
Bembidion tibiale	+	+	+	+	+	+	+	-
Bembidion decorum	++	++	++	++	+	-	++	-
Bembidion tetracolum	++	++	++	+	++	+	+	++
Bembidion 4-maculatum	-	-	-	+	-	-	-	-
Bembidion articulatum	-	-	-	-	-	-	-	++
Bembidion harpaloides	+	-	-	-	-	-	-	-
Elaphropus parvulus	+	+	-	-	-	-	-	-
Pterostichus vernalis	-	+	-	-	-	-	-	-
Agonum albipes	+	+	+	+	+	+	+	+
Agonum marginatum	+	-	-	-	-	-	-	-
Agonum micans	-	++	-	-	-	-	-	-
Agonum muelleri	+	+	+	-	-	-	-	-
Agonum viduum	-	+	-	-	-	-	-	-
Amara aenea	-	+	-	-	-	-	-	-
Amara communis	+	-	-	-	-	-	-	-
Chlaenius nigricornis	-	+	-	-	-	-	-	-
Chlaenius vestitus	+	+	+	+	+	-	+	-
Georissus crenulatus	-	-	-	-	-	-	-	++
Coelostoma orbiculare	-	-	-	-	-	-	-	+
Cercyon marinus	-	-	-	-	-	-	-	+
Anacaena globulus	-	-	-	-	-	-	-	+
Bledius pallipes	-	-	-	-	-	-	-	++
Bledius subterraneus	-	-	-	-	-	-	-	++
Ochthephilus aureus	-	-	-	-	-	-	+	-
Thinodromus arcuatus	-	-	+	-	-	-	+	-
Carpelimus similis	-	-	-	+	-	-	-	+
Platystethus alutaceus	-	-	-	-	-	-	-	+

Platystethus cornutus	-	-	-	-	-	-	+	-
Stenus boops	-	+	+	+	+	-	-	+
Stenus comma	-	-	-	+	-	-	-	-
Stenus guttula	-	+	+	-	-	-	-	+
Paederus riparius	-	+	-	-	-	-	-	-
Lobrathium multipunctum	-	-	-	-	-	-	-	+
Xantholinus longiventris	-	+	-	-	+	-	-	+
Philonthus carbonarius	-	-	-	-	-	+	-	-
Philonthus quisquiliarius	-	-	+	-	-	-	+	++
Philonthus rubripennis	-	-	-	+	-	-	-	-
Gabrius breviventer	-	+	-	-	-	-	+	+
Tasgius ater	+	-	-	-	-	-	-	-
Tachyusa atra	+	-	-	-	-	-	-	-
Tachyusa constricta	-	-	-	-	-	-	-	+
Tachyusa umbratica	-	-	-	-	-	-	-	++
Gnypeta carbonaria	-	-	-	+	-	-	-	-
Aloconota cambrica	-	-	+	-	-	-	+	-
Aloconota insecta	-	-	-	-	+	-	+	-
Atheta volans	-	-	-	-	-	-	-	+
Chiloporata longitarsis-	-	-	-	-	-	+	-	
Agriotes obscurus	+	-	-	-	-	-	-	-
Zorochros minimus	++	-	-	-	+	+	+	-
Fleutiauxellus maritimus	-	-	-	-	-	-	+	-
Oulema melanopus s.str.	-	-	-	+	-	-	-	-
Phaedon cochleariae	-	+	-	-	-	-	-	-
Phyllodecta vitellinae	-	-	-	-	-	-	+	-
Chaetocnema concinna	-	-	+	-	-	-	-	-
Barypeithes pellucidus	-	+	-	-	-	-	-	-

Worcester area, 17/6/04

Mixed weather – cloudy with minor drizzle and then sunny. Left bank of the river walked from (SO728630) near the road bridge southwest of Shelsley Beauchamp to Kingswood (SO743598). Few gravel/cobble bars were encountered; much of the banks overgrown with Himalayan Balsam and other plants. The main focus of sampling was in the Shelsley area and around Ham Bridge (near the presumed sources of previous records for *B. testaceum*). Other points on the Teme where access from roads is easy (e.g. near Stamford Bridge, ca SO715658), the Knightwick area (ca SO733559), and at various points downstream from Knightwick towards Worcester, woulkd be worth checking for suitable bars.

Samples taken at seven bars (one of them in 2 sections), between SO728628 and SO745603. Listed in order from the most upstream, samples were taken at:-

1. SO728628. Right bank, moderately long bar (ca 30m+), with some collapsed sandy bank at back of bar. Mostly cobbled (moderate size) near water's edge, but shallow layer.

2. SO729625. Left bank, small sandy bar below steep collapsed bank, near bridge.

3. SO728624. Right bank, tiny sandy bar below collapsed bank, with some large stones, near bridge.

4. SO737612. Left bank, upstream end of moderately long and mostly sandy bar, with some reeds and other vegetation and gravel/cobble layer at water's edge in places.

5. SO737612. Left bank, downstream end of same bar.

6. SO737611. Left bank, small, mostly sandy bar

7. SO737611. Left bank, small, mostly sandy bar, with some gravel/cobbles, near bridge.

8. SO745603. Left bank., moderately large bar of mixed type: some bare rock, some silt/sand, some cobbles. Much poached by livestock, and used as a picnic (and ?swimming) beach.

Coleoptera species in hand collecting/ washing samples from the Teme, 17 June 2004

++ present in some numbers

	1	2	3	4	5	6	7	8
Elaphrus riparius	+	-	-	+	-	-	+	-
Dyschirius luedersi	-	-	-	-	-	+	-	-
Clivina collaris	-	+	++	-	-	+	-	-
Clivina fossor	-	-	+	-	-	-	-	-
Asaphidion flavipes	-	+	-	-	-	-	-	-
Bembidion litorale	+	+	-	-	-	-	-	-
Bembidion properans	+	+	-	-	-	-	-	-
Bembidion dentellum	-	+	-	-	+	-	+	-
Bembidion punctulatum	++	-	-	+	+	-	++	-
Bembidion semipunctatum	+	+	-	+	+	-	-	-
Bembidion tibiale	-	-	-	+	-	-	+	+
Bembidion decorum	+	-	-	+	+	-	+	+
Bembidion testaceum	+	-	-	-	-	-	-	-
Bembidion tetracolum	+	+	+	-	-	-	-	+
Bembidion 4-maculatum	-	-	-	-	+	-	-	-
Bembidion aeneum	-	-	-	-	-	-	-	+
Bembidion lunulatum	-	+	+	+	-	-	-	+
Bembidion mannerheimi	-	+	-	-	-	-	-	-
Pterostichus nigrita	-	+	-	-	-	-	-	-
Pterostichus strenuus	-	+	-	-	-	-	-	-

Agonum albipes	+	+	-	-	+	-	-	-
Agonum assimile	-	+	-	-	-	-	-	-
Agonum micans	-	+	-	-	-	-	-	-
Agonum moestum	-	+	-	-	-	-	-	-
Orectochilus villosus	-	+	-	-	-	-	-	-
Georyssus crenulatus	++	-	-	-	-	++	-	-
Helophorus brevipalpis	++	-	-	-	-	++	-	+
Cercyon bifenestratus	+	-	-	-	-	-	-	-
Ptenidium longicorne	-	++	-	-	++	+	-	-
Tachyporus hypnorum	-	+	-	-	-	-	-	-
Tachyporus pallidus	-	+	-	-	-	-	-	-
Tachyporus obtusus	-	+	-	-	-	-	-	-
Bledius pallipes	++	++	-	++	++	+	-	-
Bledius subterraneus	+	-	-	++	+	++	-	-
Ochthephilus omalinus	+	-	-	-	-	-	+	-
Carpelimus pusillus	-	-	-	-	-	+	-	-
Carpelimus rivularis	+	-	-	-	-	+	+	-
Carpelimus similis	-	-	-	-	++	-	-	-
Carpelimus subtilicornis	-	+	-	-	++	++	-	-
Platystethus cornutus	+	-	-	-	++	-	-	++
Stenus biguttatus	+	-	-	-	-	-	-	-
Stenus bimaculatus	-	+	-	-	-	-	-	-
Stenus boops	++	-	-	-	+	-	-	-
Stenus comma	+	-	-	-	-	-	-	-
Stenus guttula	-	-	-	-	-	-	-	+
Xantholinus longiventris	+	+	-	-	-	+	-	-
Neobisnius villosulus	-	-	-	-	-	+	-	-
Philonthus quisquiliarius	+	-	-	-	-	-	+	+
Philonthus rubripennis	++	++	-	++	++	-	++	-
Gabrius bishopi	-	-	-	+	-	-	-	-
Gabrius breviventer	+	-	-	-	-	-	-	-
Tachyusa constricta	-	+	-	-	-	++	-	-
Tachyusa leucopus	-	-	-	-	-	+	-	-
Liogluta longiuscula	-	-	-	-	+	-	-	-
Atheta elongatula	++	++	+	++	++	+	+	++
Atheta palustris	-	-	-	-	-	-	-	+
Atheta volans	-	-	-	-	-	-	-	+
Atheta fungi	-	+	-	-	-	-	-	-
Chiloporata longitarsis	-	+	+	++	++	-	++	+
Oxypoda exoleta	-	-	-	-	+	-	-	-
Adrastus nitidulus	-	+	-	-	-	-	-	-
Zorochros minimus	-	-	-	-	+	-	-	-
Heterocerus fenestratus	++	-	-	-	-	+	+	+
Heterocerus marginatus	++	-	-	-	-	+	-	+
Atomaria sp.	-	+	-	-	-	-	-	-
Corticarina fuscula	-	+	-	-	-	-	-	-
Chrysolina polita	-	+	-	-	+	-	-	-
Phaedon cochleariae	+	-	-	-	-	+	-	-

Bembidiini and Laboulbeniales infections in 8 samples from the Teme, 17 June 2004.

Individuals with obvious infections in bold; those with no obvious infections in plain type.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Bembidion litorale	1	1	-	-	-	-	-	-
Bembidion properans	4	1	-	-	-	-	-	-
Bembidion punctulatum	**30**/10	-	-	**12**/1	**2**/1	-	**9**/1	-
Bembidion dentellum	-	**2**/0	-	-	**1**	-	1	-
Bembidion semipunctatum	1	6	-	2	1	-	-	-
Bembidion tibiale	-	-	-	**1**	-	-	**3**/0	**2**/0
Bembidion decorum	**3**/0	-	-	**9**/2	1	-	**5**/1	**1**/0
Bembidion testaceum	**2**/1	-	-	-	-	-	-	-
Bembidion tetracolum	**3**/8	**3**/1	**9**/0	-	-	-	-	**2**/0
Bembidion 4-maculatum	-	-	-	-	1	-	-	-
Bembidion aeneum	-	-	-	-	-	-	-	1
Bembidion lunulatum	-	**1**/4	1	1	-	-	-	2
Bembidion mannerheimi	-	1	-	-	-	-	-	-
Asaphidion flavipes	-	**5**/0	-	-	-	-	-	-

Worcester area and Monmouthshire (with Dave Bell), 28-29/7/04

Warm and mostly sunny weather. Water levels on rivers visited relatively low. The visit aimed to examine and take samples of *Bembidion testaceum* at the Teme site (Shelsley) where the species had been taken one month previously, and at the Usk site (Llangybbi) where it had been found in reasonable numbers in 2003, at the same time trying to pin down just where within the bars the species occurs. Further aims were to locate other possibly suitable bars for the species on the Usk and Teme, and also on portions of the Monnow and Wye and, if time allowed, to attempt to find *B. testaceum* at additional sites.

28 July was spent mostly on the Teme at Sites 1-4 (see below), but samples were also taken at 2 sites on the Monnow (5-6). After overnighting at Monmouth, samples were taken at one further site on the Monnow (7) and also from the banks of the Wye near its junction with the Monnow (8). The greater part of the day was spent on the Usk at and near Llangybbi, where samples were taken at 4 sites (9-12).

On the Teme, in addition to the sites sampled, easily accessible parts of the river between Stanford Bridge and Shelsley, around Ham Bridge, and downstream from Knightwick were briefly examined without bars considered suitable for *B. testaceum* being found. However, such bars are likely to exist both upstream from Stanford Bridge and between Knightwick and the confluence of the Teme and Severn at Worcester.

Many bars that are possibly suitable for *B. testaceum* are likely to be found along the long section of the Wye upstream from Monmouth, possibly as far as Hay (from whence there is an old record for the species). Sections of the Wye visible from the road between Ross and Monmouth were scanned for suitable bars, and a few worth checking at a later date were spotted. One site near Ross and the riverside at Symonds Yat (west) were reconnoitred on foot withour bars considered worthy of sampling being located.

As far as possible the section of the Monnow from its confluence with the Wye at Monmouth upstream to Tregate Bridge was checked, without locating obviously suitable bars (except for those reconnoitred on foot and sampled).

On the Usk, both banks of the river for some 400 metres upstream from the main Llangybbi site (10) were walked, as was the left bank of the river from just above Newbridge upstream for about half a mile to ST398953. Samples were taken from the few small bars on these stretches of river that were considered possibly suitable for *B. testaceum*.

Samples taken from some 12 sites in all, listed from upstream down in each instance:-

1. River Teme, SO715658, smallish bar on left bank just above footbridge at Stanford Bridge; shallow layer of cobbles at water's edge with sandy/silty areas behind.
2. River Teme, SO715657, somewhat larger bar on right bank just below roadbridge at Stanford Bridge.
3. River Teme, SO728628, as on 17 June 2004.
4. River Teme, SO733559, near Knightwick, moderate sized bar on right bank, much poached by livestock.
5. River Monnow, SO479172, narrow but rather elongate bar (or series of bars) on left bank downstream from broken down weir belowTregate Bridge.
6. River Monnow, SO479171, small bar on right bank, mostly in the shade of riverside trees; more rocks than cobbles.
7. River Monnow, SO507130, fairly long bar on right bank at Monmouth, on the edge of town; much poached by cattle, rather dirty, and partly in the shade of trees.
8. River Wye, SO512129, small elongate bar on right bank just upstream from road bridge at Monmouth; very dirty; few cobbles.
9. River Usk, ST386966 downstream to ST388965, a series of very small bars on the left bank of the river; few cobbles.
10. River Usk, ST397964, point bar visited in 2003.
11. River Usk, ST388953, point bar on right bank of similar general character to '10' but with less variety of terrain and less extensive range of sandy 'clifflets'.
12. River Usk, ST3869563 downstream to ST386951, a series of small bars on left bank around the inside of a long river bend.

Coleoptera species in hand collecting/ washing samples from the Teme, Monnow, Wye and Usk, 28-29 July 2004

++ present in some numbers

Site	1	2	3	4	5	6	7	8	9	10	11	12
Elaphrus cupreus	-		-	-	+	-	-	-	-	-	-	-
Elaphrus riparius	-		-	+	-	+	-	-	+	-	-	-
Loricera pilicornis	-		-	-	-	-	+	-	-	-	-	-
Dyschirius aeneus	-		-	-	-	-	-	+	-	-	-	-
Bembidion articulatum	-		-	+	-	+	-	+	-	-	-	-
Bembidion atrocoeruleum	-		+	-	-	-	-	-	-	+	++	-
Bembidion decorum	+		+	++	-	++	-	+	-	++	++	+
Bembidion dentellum	-		-	-	-	-	-	+	-	+	-	-
Bembidion femoratum	-		-	-	-	-	+	-	-	+	+	-
Bembidion fluviatile	-		-	-	-	-	-	+	-	-	-	-
Bembidion lampros	-		-	-	-	-	-	-	-	+	-	-
Bembidion litorale	-		-	-	-	-	-	-	+	-	-	-
Bembidion lunulatum	-		-	-	-	-	+	-	-	-	-	+
Bembidion prasinum	-		-	-	-	-	-	-	-	+	-	+
Bembidion properans	-		-	+	-	-	+	-	-	-	-	-
Bembidion punctulatum	+		+	++	-	-	-	-	+	++	++	++
Bembidion semipunctatum	-		+	++	-	-	-	-	-	-	-	-
Bembidion tetracolum	-		+	+	+	+	+	-	-	+	++	++
Bembidion testaceum	-		+	-	-	-	-	-	-	+	+	-
Bembidion tibiale	-		-	-	+	-	+	-	-	-	-	-
Bembidion varium	-		-	-	-	-	-	-	-	+	-	-
Pterostichus anthracinus	-		-	-	-	-	-	-	-	+	-	-
Pterostichus cupreus	-		-	-	-	-	-	-	-	+	-	-
Agonum albipes	+		-	+	+	+	+	+	-	-	+	-
Agonum marginatum	-		-	+	-	-	-	-	-	+	-	+
Agonum moestum	-		+	+	-	-	-	-	-	+	-	-
Chlaenius vestitus	-		-	+	-	-	-	-	-	+	+	-
Lionychus quadrillum	-		-	-	-	-	-	-	-	+	-	-
Nebrioporus depressus	-		-	-	-	+	+	-	-	-	-	-
Platambus maculatus	-		+	-	-	-	-	-	-	-	-	-
Helophorus brevipalpis	++		-	-	-	-	-	-	-	-	-	-
Cercyon bifenestratus	-		-	+	-	-	-	-	-	-	-	-
Laccobius striatulus	+		-	-	-	-	-	-	+	-	-	-
Helochares lividus	+		-	-	-	-	-	-	-	-	-	-
Ptenidium longicorne	-		+	-	-	-	+	-	-	-	-	-
Bledius annae	-		-	-	+	-	-	-	-	-	-	-
Bledius gallicus	-		-	-	-	-	-	-	-	-	-	+
Bledius pallipes	++		-	++	+	++	+	-	++	-	-	-
Bledius subterraneus	-		-	-	+	+	+	-	+	-	-	-
Carpelimus subtilicornis	+		-	-	+	-	+	+	-	-	-	-
Platystethus cornutus	-		-	-	-	-	-	+	-	-	-	-
Anotylus rugosus	-		-	+	-	-	+	-	-	-	-	-
Oxytelus laqueatus	-		-	-	-	-	-	+	-	-	-	-

Stenus biguttatus	-	-	-	-	-	-	-	+	-	-	-
Stenus boops	-	+	+	-	-	-	-	-	-	-	-
Stenus comma	-	+	-	-	+	+	+	+	+	+	-
Stenus guttula	-	-	-	-	+	-	+	-	-	-	-
Stenus tarsalis	-	-	-	-	+	-	-	+	-	-	-
Paederus riparius	-	-	-	-	+	-	-	-	-	-	-
Neobisnius prolixus	-	-	-	-	-	-	-	-	++	+	+
Philonthus quisquiliarius	-	-	+	-	-	-	-	+	-	-	+
Philonthus rubripennis	-	+	+	-	+	-	-	+	+	-	-
Gabrius nigritulus	-	-	-	-	-	-	+	-	-	-	-
Myllaena intermedia	-	-	+	-	-	-	-	-	+	-	-
Tachyusa umbratica	+	-	-	-	-	-	-	-	-	-	-
Hydrosmecta fragilis	+	-	-	-	-	-	-	-	-	-	-
Atheta elongatula	-	-	-	+	-	+	-	-			
Atheta hygrotopora	+	-	-	-	+	+	-	-			
Atheta volans	-	-	-	-	-	-	-	-	-		
Aphodius granarius	-	-	-	-	-	-	-	-	+	-	-
Heterocerus marginatus	++	-	-	-	-	-	-	+	-	-	-
Oulimnius tuberculatus	-	-	-	-	-	-	-	+	-	-	-
Zorochros minimus	-	-	+	-	-	-	-	-	++	-	-
Adalia bipunctata	-	-	-	-	-	-	-	-	++	-	-
Coccinella 5-punctata	-	-	-	-	-	-	-	-	++	-	-
Notoxus monoceros	-	-	-	-	-	-	-	-	+	-	-
Gastrophysa viridula	-	+	-	-	-	-	-	-	+	-	+
Phaedon armoraciae	-	-	+	-	-	-	-	+	-	-	-
Phaedon cochleariae	-	-	-	-	-	-	+	+	+	-	-

Bembidiini and Laboulbeniales infections in 11 samples from the Teme, Monnow, Wye and Usk, 28-29 July 2004.

Individuals with obvious infections in bold; those with no obvious infections in plain type.

Site	1	3	4	5	6	7	8	9	10	11	12
Bembidion articulatum	-	-	**1**/1	-	**0**/1	-	**1**/0	-	-	-	-
Bembidion atrocoeruleum	-	**1**/0	-	-	-	-	-	-	**1**/0	**8**/0	-
Bembidion decorum	**1**/1	**2**/0	**2**/38	-	**1**/8	-	**0**/3	-	**8**/17	**2**/6	**2**/3
Bembidion dentellum	-	-	-	-	-	-	**0**/1	-	**1**/0	-	-
Bembidion femoratum	-	-	-	-	-	**0**/2	-	-	**2**/1	**0**/1	-
Bembidion fluviatile	-	-	-	-	-	-	**0**/1	-	-	-	-
Bembidion lampros	-	-	-	-	-	-	-	-	**0**/2	-	-
Bembidion litorale	-	-	-	-	-	-	-	**0**/2	-	-	-
Bembidion lunulatum	-	-	-	-	-	**1**/2	-	-	-	-	**4**/0
Bembidion prasinum	-	-	-	-	-	-	-	-	**1**/1	-	**0**/1
Bembidion properans	-	-	**0**/1	-	-	**0**/1	-	-	-	-	-
Bembidion punctulatum	**3**/1	**0**/2	**9**/20	-	-	-	-	**2**/1	**10**/0	**11**/3	**7**/6
Bembidion semipunctatum	-	**1**/0	**5**/0	-	-	-	-	-	-	-	-
Bembidion tetracolum	-	**3**/2	**0**/1	**0**/1	**0**/2	**0**/1	-	-	**0**/1	**1**/10	**3**/2
Bembidion testaceum	-	**1**/0	-	-	-	-	-	-	**0**/1	**1**/2	-
Bembidion tibiale	-	-	-	**8**/9	-	**2**/0	-	-	-	-	-
Bembidion varium	-	-	-	-	-	-	-	-	**0**/1	-	-

South Devon (with Beth Okamura) 26-28/8/04

Following heavy recent rains, water levels were high on all rivers visited. Nevertheless, the character of the rivers and their banks could be assessed, and in all instances, with the possible exception of the Dart, possible suitable habitat for *Bembidion testaceum* was found. No large point bars were found on the Axe or Yarty, while those found on the Otter are of modest size.

26/8/04
Fine weather.
River Axe: inspected from the road at ST325025 and at various other points south to its confluence with the Yarty at SY283973. A small bar (photographed) found at ST322014, and sample taken there (Axe 1). The river at this point some 50cm above usual summer level.

River Yarty: the lowest reaches of the river west of Axminster inspected. One small bar found (photographed) and sampled (Yarty 1) at SY282978. As on the Axe, water levels high.

River Otter: the lowest section, from Otterton (SY079853) south to the mouth (SY076820), had been inspected on foot on a previous visit in March 2004, when only a few small bars had been found. So, reaches higher up the river

were inspected by walking from Ottery St Mary (SY095955) south to SY093936. Two bars of modest size (photographed) were found at SY095946 (Otter 1) and SY096940 (Otter 2) and sampled.

River Teign: the lowest accessible parts above Newton Abbott were inspected on foot, from SX858734 to SX852748. Several small bars were found and the largest of these, at SX855743 (photographed) was sampled (Teign 1); a flood debris sample was taken from the same site.

27/8/04
Moderate rain in the morning, easing by early afternoon; warm and dry later.

River Dart: inspected at various points: above Buckfastleigh (ca SX733705) where the river has a gravel bed and very fast flowing, at Buckfastleigh (ca SX748661), and at various points downstream from there as far as Totnes (SX806602). The river banks were walked from SX800614 to SX807608 where the water levels were exceptionally high (?80cm above usual summer levels) and no bars were visible above water. Below Totnes the river is tidally influenced, and the large weir at Totnes and weirs higher up the river probably have a considerable influence on water levels in the lower but non-tidal reaches of the river. The river banks were also walked higher up the river near Staverton Bridge (SX778635 to SX785638), where one substantial midstream bar (inaccessible) was seen at SX784636, but no bars above water were seen elsewhere. A flood debris sample was taken at SX782635.

28/8/04
Fine weather, with a small shower late afternoon.

River Teign: banks inspected on foot from SX855746 and SX849758. Two large bars visited previously in 1998, at SX850749 (Teign 2) and SXZ 851748 (Teign 3) were revisited and sampled. Both bars are now more heavily vegetated, especially by invasive Himalayan Balsam than in 1998. A third bar, cut off by a small side channel, at SX 858735 (Teign 4) was also sampled.

River Exe: this was inspected from the road at various points between Exeter (SX914922) and Tiverton (SS952121). Only one large bar was seen, on the left bank, on a long bend near Nether Exe. This was partly under recently risen water, but was sampled extensively (Exe 1).

Coleoptera species in hand collecting/ washing samples from the Axe, Yarty, Otter, Teign and Exe, 26-28 August 2004

1 = Axe 1; 2 = Yarty 1; 3 = Otter 1; 4 = Otter 2; 5 = Teign 1; 6 = Teign 2; 7 = Teign 3; 8 – Teign 4; 9 = Exe 1.

++ present in some numbers

	1	2	3	4	5	6	7	8	9
Elaphrus cupreus	+	-	-	-	-	-	-	-	-
Elaphrus riparius	-	-	-	-	-	+	-	-	-
Perileptus areolatus	-	-	-	-	-	-	+	-	-
Bembidion atrocoeruleum	-	+	-	++	++	++	+	++	++
Bembidion decorum	-	++	-	-	+	++	+	+	++
Bembidion lampros	+	+	-	-	-	-	+	-	+
Bembidion punctulatum	++	+	+	+	+	+	+	+	+
Bembidion tetracolum	+	+	+	-	-	-	-	-	+
Bembidion tibiale	-	-	+	-	+	+	-	-	+
Agonum albipes	+	+	-	-	+	+	+	+	+
Harpalus rufipes	+	-	-	-	-	-	-	-	-
Helochares lividus	-	-	-	+	-	-	-	-	-
Laccobius striatulus	+	+	+	+	-	-	-	-	-
Hydraena rufipes	-	+	-	-	-	-	-	-	-
Carpelimus rivularis	-	+	-	-	-	-	-	-	-
Stenus boops	+	-	-	-	-	-	-	-	-
Stenus comma	-	-	-	-	-	+	-	-	-
Paederus littoralis	-	-	-	-	-	-	-	-	++
Xantholinus longiventris	-	-	-	-	-	-	-	+	+
Neobisnius prolixus	-	-	-	-	-	-	-	-	+
Deinopsis erosa	-	+	-	-	-	-	-	-	-
Myllaena intermedia	-	+	-	-	-	-	-	-	-
Hydrosmecta thinobioides	-	-	-	-	-	-	-	-	+
Dryops ernesti	-	+	-	-	-	-	-	-	-
Heterocerus fenestratus	-	+	+	-	-	-	-	-	-
Heterocerus marginatus	-	-	-	+	-	-	-	-	-
Zorochros minimus	-	-	-	-	-	-	-	-	++
Propylea 14-punctata	-	-	-	-	-	-	+	-	-
Phaedon cochleariae	-	-	+	-	-	-	+	-	+
Gastrophysa viridula	-	+	-	-	+	-	+	-	-
Prasocuris junci	-	-	+	-	-	-	-	-	-

Bembidiini and Laboulbeniales infections in 9 samples from the Axe, Yarty, Otter, Teign and Exe, 26-28 August 2004.

1 = Axe 1; 2 = Yarty 1; 3 = Otter 1; 4 = Otter 2; 5 = Teign 1; 6 = Teign 2; 7 = Teign 3; 8 – Teign 4; 9 = Exe 1.

Individuals with obvious infections in bold; those with no obvious infections in plain type.

	1	2	3	4	5	6	7	8	9
Bembidion atrocoeruleum	-	**0**/5	**-**	**7**/7	**6**/8	**15**/17	**2**/2	**44**/20	**18**/215
Bembidion decorum	-	**5**/29	-	-	**1**/2	**6**/5	**0**/2	**2**/2	**10**/26
Bembidion lampros	**0**/1	**0**/1	-	-	-	-	**0**/1	-	**0**/2
Bembidion punctulatum	**1**/7	**1**/0	**0**/1	3**(1)**	**0**/1	**0**/1	**2**/4	**0**/1	**1**/0
Bembidion tetracolum	**1**/2	**0**/1	**0**/1	-	-	-	-	-	**5**/6
Bembidion tibiale	-	-	**0**/1	-	**0**/4	**-**	**-**	**-**	**½**

Coleoptera species in flood debris samples from the Teign and Dart, 26-27 August 2004

1 = River Teign, 26/8/04, SX855743
2 = River Dart, 27/8/04, SX782635

++ present in some numbers

	1	2
Trechus obtusus	-	+
Trechus quadristriatus	-	+
Trechus subnotatus	-	+
Bembidion biguttatum	+	-
Bembidion guttula	-	+
Bembidion lunulatum	-	+
Bembidion tetracolum	+	-
Elaphropus parvulus	+	-
Pterostichus cupreus	+	-
Pterostichus nigrita	+	-
Pterostichus strenuus	++	++
Pterostichus vernalis	+	-
Agonum albipes	+	-
Agonum fuliginosum	-	+
Agonum gracile	+	-
Agonum moestum	+	-
Agonum muelleri	+	-
Agonum obscurum	+	-
Harpalus rufipes	+	-
Helophorus brevipalpis	+	+
Megasternum obscurum	-	+
Ptenidium fuscicorne	++	+
Ochthebius bicolon	+	-
Ochthebius dilatatus	+	-
Lesteva heeri	+	-
Lesteva longoelytrata	+	-
Lesteva punctata	+	-
Ochthephilus angustior	+	-
Ochthephilus aureus	+	-
Carpelimus corticinus	+	-
Anotylus rugosus	++	+
Stenus bimaculatus	+	+
Lathrobium brunnipes	+	+
Xantholinus longiventris	+	-
Philonthus tenuicornis	+	-
Gabrius astutus	+	-
Gabrius breviventer	+	-
Gabrius nigritulus	+	+
Quedius curtipennis	-	+
Quedius umbrinus	+	++

Ischnosoma splendidum	+	-
Tachinus laticollis	+	-
Sepedophilus constans	++	+
Sepedophilus marshami	-	+
Tachyporus chrysomelinus	+	-
Tachyporus hypnorum	+	+
Aloconota insecta	+	-
Amischa decipiens	+	-
Atheta fungi	+	+
Atheta negligens	-	+
Atheta obfuscata	++	-
Atheta laticollis	+	-
Ocalea picata	-	+
Ocalea rivularis	+	-
Oxypoda elongatula	+	+
Oxypoda exoleta	+	-
Aphodius prodromus	+	-
Clambus nigrellus	++	-
Zorochros minimus	+	-
Lycoperdina bovistae	+	-
Phaedon cochleariae	+	-
Longitarsus luridus	+	-
Hypera pollux	+	-

Surrey rivers (with Beth Okamura), 5 /9/04

Warm and sunny weather. River levels high.

Mill Bourne near Chobham:
The small river (Mill Bourne) running through Chobham investigated on foot from SU974620 eastwards (downstream) to SU993619. The banks are mostly overgrown with thick vegetation including Himalayan Balsam and nettles, and are tree-shaded in many places. No substantial bars were found but small areas of broken-down sandy bank were checked and sampled. Further downstream where the river appears to meander through open countryside (ca TQ0262 to TQ0564) might be worth investigating.

River Wey near Weybridge:

River banks walked from Weybridge (TQ068647) south to TQ063635. No bars found, but small areas of broken-down sandy bank with narrow ‘under-cliff’ were investigated and sampled. Upstream areas, e.g. around Guildford and Godalming, would be worth checking for bars.

Coleoptera species taken by hand collecting/ washing sandy banks of the Mill Bourne and River Wey, Surrey, 5 September 2004

	Mill Bourne	River Wey
Nebria brevicollis	+	-
Bembidion articulatum	-	+
Bembidion guttula	+	-
Bembidion harpaloides	+	-
Bembidion lampros	+	-
Bembidion tetracolum	++	++
Asaphidion flavipes	++	+
Agonum albipes	+	+
Chlaenius vestitus	-	+
Laccobius striatulus	-	+
Bledius pallipes	-	++
Stenus bimaculatus	+	-
Stenus boops	+	-
Stenus comma	+	-
Paederus riparius	+	-
Oxypoda elongatula	+	-

Appendix B

Bembidion testaceum: Field Notes

David Bell

Site Visits to Rivers Teme, Wye, Monnow, Usk: 28 & 29.7.04

Worcestershire and South Wales - 28.7.04

Staff: Peter Hammond & Dave Bell

River Teme

Ham bridge (SO 737 610), looked from bridge, site of old record. Very little suitable habitat. Odd very small lateral bars visible. Photo x1.

Shelsey Beauchamp (SO 72870 62758). Historical-record site where Peter found testaceum on 17.6. RHB. Re-found several specimens, but only in very limited part of bar (approx two-thirds up, towards upstream end, near water, in cleaner gravel areas). Areas further downstream are silty with sticky brown mud visible when stone-turning. Poss BT avoids such areas? Photo x2 BT x5.

Stanford Bridge (SO 71576 65693). 2 Very low lying bars, but clean. Just downstream of bridge. RHB Photo x4 BT x1. Also some bars upstream of bridge, LHB but no BT found. Photo x1.

Several other access points checked between Shelsey Beauchamp and Stanford Bridge, but no suitable habitat encountered.

Knightwick. (SO 73364 55952). No BT found, though many rufinistic decorum. RHB. Photo x2.

Several other access points checked between Knightwick and Worcester, but no suitable habitat encountered. However, without walking whole length of river, it is very possible some suitable habitat for BT may exist along this stretch.

River Wye

Several sites stopped at beside A40 between Ross-on-Wye and Monmouth, including Goodrich. Some sites looked possible but not checked out, esp. downstream of B4260 road bridge (SO 590 242) close to Ross.

River Monnow

Drove length of Monnow from Monmouth to Tregate Bridge and back, stopping at possible looking sites, but very little suitable habitat seen.

Tregate Bridge (SO 47774 17221). Scrappy little pieces of ERS formed when weir collapsed. LHB. Photos x2 BT x1. Walked three-quarters mile downstream, no shingle at all apart from very small scrappy pieces just upstream of Clappers Wood (SO 470 184). RHB & LHB. Very little shingle along this river. No BT or Photos.

Wales - 29.7.04

River Monnow

Monmouth (SO 5115712806). Several small lateral bars (all RHB) close to town centre. No BT. Photos x2.

River Wye

Monmouth A466 Roadbridge (SO 50779 12996). Aquatic weed-covered bar just upstream of roadbridge. Pretty much unsuitable habitat for BT. RHB. Photos x2

River Usk

Upstream of Llangibby Bottom A (ST 38528 96626) by approx 300 metres. LHB. Narrow lateral bar. Photo x1 BT x1.

Llangibby Bottom A. (ST 38528 96626) Previous records from this site in 1998, 2003. Very large and complex bar with much sand. RHB. All finds of BT concentrated in upstream third of bar. Most success in area of steeply banked fins sand which dived straight into water and which had pebble/cobble overlay. None found under cliff-lets as in 2003, though this was much less comprehensive look-see. Photos x21 BTx4.

Upstream of Newbridge (most downstream ST 38484 95162). All LHB. Walked this whole meander but only several small lateral bars between Newbridge and Llangibby B. No BT Photo x3. Well poached and fairly mucky with silt, organic stuff etc.

Llangibby Bottom B (ST 38809 95289). RHB. Very sandy bar, heavily trampled by sheep/humans, as in 1998. Most success again from areas shelving steeply into the water, though here a little less sand than Llangibby B, with several layers of cobbles. These areas were found mainly in the middle section on the bar. Other areas were briefly searched but to no avail. Photo x12 BT x3.

Other species encountered during searches

Species	1	2	3	4	5	6	7	8	9
Bembidion articulatum						+			
Bembidion atrocoeruleum								+	
Bembidion decorum	+	+	+	+		+	+	+	+
Bembidion femoratum									+
Bembidion fluviatile						+			
Bembidion genei						+			
Bembidion lunulatum	+					+		+	
Bembidion prasinum							+		
Bembidion properans								+	
Bembidion punctulatum	+	+	+				+	+	+
Bembidion quadrimaculatum								+	
Bembidion testaceum	+	+		+			+	+	+
Bembidion tetracolum	+		+		+		+	+	+
Bembidion tibiale					+				

Site Codes:

1. Shelsey Beauchamp (Teme)
2. Stanford Bridge (Teme)
3. Knightwick (Teme)
4. Tregate Bridge (Monnow)
5. Monmouth (Monnow)
6. Monmouth (Wye)
7. Upstream of Llangibby Bottom A (Usk)
8. Llangibby Bottom A (Usk)
9. Llangibby Bottom B (Usk)

Yorkshire, Northumbria and Cumbria - 5.8.04

Site Visits to Farnham and Otley Gravel Pits and Rivers Derwent (N. Yorks), Irthing, South Tyne, Allen, Tyne: 5-10.8.04

Staff: Dave Bell

Weather fine and warm.

Farnham Gravel Pits

Pit 1 (SE338602) Site of old record. No suitable habitat. Now a small fishery (trout). Some bare sand/gravel under water but edges heavily vegetated (*Juncus* spp. 'bulrush' etc. The occasional bare bank is silty. Site very small, walked whole perimeter. No shingle spp. Excavating ended here pre-1980. Photo x3.

Pit 2 (SE 349 599). Sailing and boating lake. Some gravel around banks but silty and with lake 'wash-up' on it (i.e. vegetation, organic material etc.). No shingle spp. Prob. no suitable habitat for BT. Walked South shore only. Excavating ended here approx. 1980. Photo x3.

Pit 3 (SE 351 593). This lake is a nature reserve belonging to Harrogate and District Naturalists' Society. Fishing all way round, plus birdwatching hide. Walked whole perimeter. Quite a lot of shore shingle, plus a number of bare areas (mostly silty) but no shingle spp. Nothing approaching BT habitat. Excavating ended here approx. 1985 Photo x5.

Pit 4 (SE 358 590). Owned by Tarmac. Perhaps the most promising of all the Farnham pits, due to relative 'newness,' excavation only having finished around 8 years ago (1996). Thus vegetation around shores less mature, larger areas of bare shingle. However, no shingle spp. And the edge resembles shore rather than riparian habitat, though with several areas of bare sand overlaid with pebble. South and east shores walked. Photo x4.

Pit 5 (SE 360 579) Very similar to Pit 2. Very low habitat potential for BT, viewed NW shore only. Much more mature shoreline (trees etc.). Excavating ended here approx. 1980. Photo x3.

Other species encountered during searches at Farnham Gravel Pits

Species	Pit 1	Pit 3	Pit 4
Agonum albipes		+	
Bembidion genei	+		
Bembidion obliquum		+	
Bembidion tetracolum			+
Bradycellus ruficollis			+
Dyschirius globosus			+
Elaphrus cupreus		+	
Elaphrus riparius	+	+	
Pterostichus madidus			+
Pterostichus melanarius			+

Otley Gravel Pits

These 2 pits were visited on the suggestion of Roy Crossley who thought they may be analogous to the habitat he sampled when he recorded BT from FGP in 1976. They are situated just East of Otley, close to the North bank of the River Wharfe.

Pit 1 (SE 188 458). Mature gravel pit (trees, lush vegetation on lake shore), odd shingle bit where human access to water has trampled the shore down. No suitable habitat. Sailing/recreation lake. Viewed at South and East shores. Photo x2.

Pit 2 (SE 192 454). Mature gravel pit (trees, lush vegetation on lake shore). No suitable habitat. Nature reserve managed by Wharfedale Naturalists Society. Viewed at South shores. Photo x2.

River Derwent (North Yorkshire) & Rivers Rye and Seven (tribs of Derwent)

No suitable habitat on any of these rivers, or at any of the sites visited below: river here is heavily vegetated down to the water's edge – choking the river in many spots. The river has almost certainly been heavily channelised (deepened) as a flood defence method, thus no opportunity for gravel shoals to form. Flood embankments on either side of the river (see photos) also

contribute to the controlling of the rivers. The areas visited below were targeted as potential habitat due to the very meandering course of the river at these locations. No BT habitat. No samples taken.

Old Malton (SE 800 727). River Derwent. Photo x2.
Howe Bridge (SE 809 760). River Rye. Photo x2.
Newsham Bridge (SE 748 760). River Rye. Photo x2.
Butterwick Bridge (SE 731 775). River Rye. Photo x2.
Near Brawby (SE 742 782). River Seven. Photo x2.

Yorkshire Derwent - 6.8.04

Weather fine and warm.

River Derwent

Yedingham. (SE 892 796). Heavily managed river, deeply channelised and embanked. No BT habitat. Photo x2.

Brompton Bridge (SE 953 794). Heavily managed river, deeply channelised and embanked. No BT habitat. Photo x2.

West Ayton. Very meandering section of Derwent before it becomes heavily channelised and embanked farther downstream. Very small here – more like a large stream. Virtually no shingle, very few bits visible on stream bottom. Vegetation right down to river. The little exposed areas that exist are silty. Photos and locations as below. Walked from Photo 1 to Photo 3. No BT habitat. Note that since early BT records in this area the water management of this section has changed greatly: now most flood water doesn't come down the Derwent but is siphoned off much farther upstream (SE 973 884) along North Bank Drain (= Scalby Beck) – as from 30 years ago. Thus, presumably, the whole river downstream of this point has become much more stabilised. All BT records pre-date this change.

Site 1 (SE 993 841). Photo x2.
Site 2 (SE 993 839). Photo x1.
Site 3 (SE 995 836). Photo x2.

Forge Valley (SE 988 848 -). Drove up along this stretch (river beside road), between West Ayton Bridge and picnic area at the Northern end of forge Valley NNR. Stopped and looked at various points. This is apparently the site of historical records. No BT habitat here. Wooded valley, with vegetation thick right down to water's edge. Photo x1 at West Ayton Bridge (SE 987 847). Photo x1 from bridge at picnic area (SE 984 871).

Walked from picnic area at SE 984 871 all the way to SE 938 921, following the course of the river and sampling where appropriate:

Sites 4-6. No suitable areas here, channel choked with vegetation, mature trees lining bank, despite river opening out into more open country North of the

wooded valley NNR. In fact channel became even more choked. These photos typical of the river along this stretch.

Site 4 (SE 984 871). Bridge at Picnic area. Photo x1.

Site 5 (SE 979 878). Photo x1.

Site 6 (SE 975 882). Photo x1.

Site 7 (SE 972 884). Weir Head at North Bank Drain (see above) Photo x2. This drain looks like an overflow drain taking water away from the Derwent.

Site 8 (SE 969 885). First potential search area, though perhaps of low potential. 2 small bars plus some shingle at base of eroding cliffs. Perhaps significant that gravels now started to appear upstream of North Bank Drain. Pebble overlaying coarse sand, clean. Sample taken. Photo x3

Site 9 (SE 969 887). Just upstream from Site 8, very similar habitat and a series of small bars on a very meandering piece of river. Some potential, but probably low. Sample taken. Photo x3.

Site 10 (SE 968 888). Further upstream. Ditto sites 8 & 9. Sample taken. Photo x1

Site 11. (SE 967 892). Wrench Green bridge. No suitable habitat. Photo x2.

Site 12 (SE 967 896). Searched, but no sample taken. Species similar to Sites 8-10. Photo x1

Sites 13 & 14 (SE 954 899). Footbridge at Woodhouse. No suitable habitat. All bars in this section very narrow laterals, silty. Photo x2

Site 15 (SE 956 901). Searched, but sample not taken. Species as above. Photo x1.

Site 16 (SE 947 900). Road Bridge at Estell Lane. No suitable habitat. Photo x2.

Site 17 (SE 946 903). Sites 17 and 18 were the best examples of several similar types of bar in this section (between Estell Lane and Bridge Farm). Searched & sample taken. Photo x1

Site 18 (SE 944 905) Searched & sample taken. Photo x1

Site 19 (SE 941 909). D/S Bridge Farm. Searched, but sample not taken. Species as per sites 16 & 17. Photo x1

Site 20 (SE 942 910). Road Bridge at Bridge Farm. No suitable habitat. Photo x1

Site 21 (SE 939 915). Not searched. This bar typical of the shingle in the section U/S of Bridge Farm to the walk end point at SE 938 921. All these bars

were typical of bars found on small, wooded streams, virtually nil potential for BT. Beginning also to get towards the uplands here. Photo x1

Other species encountered during searches on the River Derwent

Species	Site 8	Site 9	Site 10	Site 17	Site 18
Agonum albipes	+	+		+	
Bembidion articulatum		+			
Bembidion dentellum	+	+		+	+
Bembidion tetracolum	+	+	+		+
Bembidion tibiale	+	+		+	+

Cumbrian Rivers - 7.8.04

Weather fine and hot.

All the Irthing and Kings Water sites have a reasonable BT potential – much more so than any of the sites in Knaresborough and Scarborough areas. The Kings Water/Irthing confluence area looked particularly likely with many clifflets and larger areas of bare sand eroding directly into the water. However, no BT found.

River Irthing

Site 1. (NY 540 633). This and sites 2-5 presumably the historical record sites for BT at 'Easby.' Much less sand than anticipated at this site, though some clean, coarse sand under the pebbles. Possible BT habitat. Area searched and sample taken. Photo x1

Site 2. (NY 539 633). Very similar to site 1. Possible BT habitat. Area searched and sample taken. Photo x1

Site 3. (NY 538 632). Similar to site 1. Possible BT habitat, though gravel rather than sand underlying this bar. Area searched and sample taken. Spp as per other bars in this section Photo x1

Site 4. (NY 537 632). Very similar to site 1. Possible BT habitat. Area searched and sample taken. Photo x1

Site 5. (NY 535 633). Similar to site 1. Possible BT habitat. Area searched but no sample taken. Spp as per other bars in this section Photo x1

8.8.04

Weather fine and hot.

Irthing

Site 8. (NY 520 631). Briefly searched, no samples taken. Very much as per sites 1-5 above. Photo x1

Site 9. (NY 523 632). Just below confluence of Kings Water & Irthing. Searched and sample taken. Some fine sand in the matrix here. Photo x1.

Irthing/Kings Water Confluence

Site 10 (NY 524 633). Very nice looking piece of habitat here – the river clearly very mobile at this point. A complex of lateral and mid-channel bars. Lots of sand in the matrix, including some very fine sand (aka the Usk). Many clifflet areas, all of which were systematically searched. Approx 2.5 hours spent in this area, to no avail. Looked like very good potential habitat for BT. Sample taken. Photo x5.

Kings Water

Site 11 (NY 524 633) Several hundred yards U/S of the confluence area. Again very good looking area for BT – some nice areas of fine sand eroding directly into the water, with a pebble overlay. Approx 1.5 hours spent here, again with no BT turned up. River again clearly very mobile here. Sample taken Photo x3.

Irthing

Returned to River Irthing to search areas upstream of the confluence with Kings Water.

Site 6 (NY 533 634). Some good areas of shore line eroding steeply into the water, though sand underneath was coarse. These areas systematically searched, without finding BT Nevertheless good potential for BT. Sample taken Photo x1

Site 7. (NY 533 632) Searched but no sample taken. Similar habitat to Sites 1-5. Spp as per Site 6. Photo x1

Site 12 (NY 535 635). Briefly searched, but very similar to Sites 1-5. No sample taken. Note that this area is marked on the map as one large point bar on the south bank but now exists as several smaller bars on the North and south banks, the river meandering between them. Photo x1

Other species encountered during searches of River Irthing/Kings Water

Species	Site 1	Site 2	Site 3	Site 4	Site 6	Site 9	Site 10	Site 11
Agonum albipes				+			+	+
Bembidion atrocoeruleum		+	+	+	+	+	+	+
Bembidion decorum		+		+	+	+	+	+
Bembidion litorale							+	+
Bembidion monticola			+				+	
Bembidion prasinum				+			+	
Bembidion punctulatum			+			+	+	+
Bembidion tetracolum	+	+		+	+	+	+	+
Bembidion tibiale	+					+	+	
Elaphrus riparius	+						+	+

Northumbria - 9.8.04

Weather very wet, rained all day with frequent torrential downpours. No possibility of searching in this weather, but the following sites were visited and sites pinpointed for searching on a future date.

River South Tyne

Site 1 (NY 785 640). Beltingham. Historical (1996) BT Record, presumably from here of Site 2 (below). Some nice areas of bare sand and sand overlaid with pebbles. Looks very good potential for BT. Photo x1

Site 2 (NY 790 642). Beltingham. Just U/S of railway bridge across river. Very large bar with many areas of bare sand and sand overlaid with pebbles. Looks very good potential for BT. Photo x2

River Allen

Site 3 (NY 800 587). Right at the confluence, this bar has formed directly opposite where the River West Allen meets the River East Allen. Reasonable potential for BT, though sand is fairly coarse. Photo x2

Site 4 (NY 800 588). Just D/S of the confluence, there are some (limited) areas of fine sand which will be worth a look. Photo x1

River Tyne

Site 5 (NY 918 660). Opposite where the South Tyne empties into the North Tyne. Bar not visited but looks like some bare sand areas at the D/S end. This is the site of several records 1979-1987. Photo x1

Site 6 (NY 920 657). Immediately D/S of Confluence, on the RHB. Less sand here than at Beltingham, and where the sand is present it is coarse. Also some siltation from the mid to D/S end. Photo x2

10.8.04

Weather still very wet, river very high, pretty much in spate.

River Tyne at Corbridge Road Bridge, showing high water levels on the Tyne. Photo x3

16.8.04

Site Visits to Rivers South Tyne, Allen, Tyne and Devil's Water: 16-18.8.04

Staff: Dave Bell

Weather warm but interspersed with heavy showers.

River South Tyne

Site 1 (NY 785 640). Beltingham. Upstream site only visited due to downpour. Hand searched mainly away from main channel – water's edge almost completely devoid of life, presumably due to lack of recolonisation post-spate. On almost all of bar very little Coleopteran life, except for "hotspot" at the top of sandy cliff where pool had formed beneath (see photos). Sand almost completely still wet right across the bar, except where BT and most of the other carabids were found. Sample taken. Searched for 3 hours. Photo x4 BT x2

River Allen

Site 2 (NY 800 587). Search concentrated on the bar right at the confluence, again as per Site 1 the sand very wet and nothing moving at water's edge. Most individuals found farther back against cliff/steep drop off where gravels overlay sand cliff. Sample taken but no BT. Searched for 1.5 hours. No photos taken – see photos from previous site visit.

17.8.04

Weather warm but interspersed with showers, occasionally heavy (esp. later in afternoon).

River Tyne

Site 3 (NY 920 657). Immediately D/S of Confluence, on the RHB. Again very little life adjacent to water: almost all specimens taken from drier sand areas higher up on bar. Sand mostly still wet. Numbers of all *Bembidion* spp. very low. Sample taken but no BT. Searched for 2 hours. No photos taken – see photos from previous site visit.

River South Tyne

Site 4. (NY 910 659). Road bridge at Bridge End, near to Warden. Approx. quarter mile U/S of Tyne confluence. Looked like excellent habitat – much sand, mostly fine, overlaid (often sparsely) by cobble and boulder. Also some large bare sand areas. Note that (again) most sand still very damp. Sample taken but no BT. Searched for 1 hour. Photo x2.

Site 5 (NY 900 666). Opposite (working) paper mill. Huge bar on RHB. Again looked like excellent habitat – some extensive steep sloping banks directly into water, with cobble overlaying fine and coarse sand. However, very difficult to find any *Bembidion*. Searched for 1 hour. No sample taken. No BT. Photo x2.

River Tyne

Site 6 (NY 918 660). Opposite where the South Tyne empties into the North Tyne. Looked superficially poorer than anything else in the last 2 days – some small bare patches of fine sand but not a lot. Reminiscent of River Teme. All water edge was smaller pebbles over-laying coarse sand. As with all Tyne area sites, gravels very clean. Following capture of BT specimens, the whole bar was systemtically searched from waters edge to 2 metres in. Both BT found not at water's edge, but approx. 1.5m back, three-quarters of way downstream bar. Almost all *Bembidion* individuals encountered at this site were found 1.5-2m from water's edge. Note that higher water levels meant that the bar was significantly smaller than when original photos taken. Substrate photos taken where BT were found. Searched for 2.5 hours. Sample taken. Photo x4. BT x2 (only one taken).

18.8.04

Weather started wet but then fine, heavy showers later in afternoon.

River Devil's Water

Site 7. (NY 975 643). This presumably the site of the historical record at "Dilstonhaugh." The whole section of the footpath walked from Dilston (NY 975

635) to Corbridge Road Bridge (NY 988 641), but this site the only appropriate habitat – no exposed shingle at all on the Tyne itself. Devil's Water is a tributary of the Tyne, and this site is only approx 200 yards from confluence. This site looked like suitable habitat, plenty of sand. Very low numbers of carabids recorded – count only amounted to a total of 14 individuals in 3 hours. Substrate photos taken where BT were found. Searched for 3 hours. Sample taken. Photo x5. BT x1

Site 8. River Tyne at Devil's Water confluence (NY 975 644) – these photos typical of the Tyne along this stretch. Photo x2

Site 9. River Devil's Water at Dilston Road Bridge (NY 975 635). Possible further habitat for BT, upstream of the Site 7 record. U/S & D/S Photos. Photo x2

Site 10. River Devil's Water at Linnels Bridge (NY 955 616). Probably little suitable habitat this far up on Devil's Water – becomes very wooded upstream of here, and somewhat wooded downstream also (see maps): most likely little suitable habitat U/S of Dilston. Photo x2

River Till

Site 11. EMS 1987 report Doddington Bridge site (NT 998 307), no exposed areas visible, but river in spate. Photo x2

Walked River Till from NT 991 313 to NT 985 320. Despite high water levels there were large areas of exposed sand visible at almost all of these sites. However, the substrate was almost 100% fine sand – at best a thin gravel/very occasional pebble overlay in a few areas. Very nice sand ERS, but probably little value for BT, or indeed many other shingle spp. No samples taken, weather poor and thus no beetles moving. Prob low population levels of Coleoptera anyway – no shelter on the bare sand! Photos showing the sandbanks as below:

Site 12 (NT 992 313) – Photo x1
Site 13 (NT 988 316) – Photo x1 (Eyre Site 3 in 1992 Survey)
Site 14 (NT 985 316) – Photo x2
Site 15 (NT 986 317) – Photo x1
Site 16 (NT 983 318) – Photo x1
Site 17 (NT 984 320) - Photo x1

Other species encountered during searches of River South Tyne/Tyne/Allen/Devils Water

Species	Site 1	Site 2	Site 3	Site 4	Site 6	Site 7
Agonum albipes	+		+			
Bembidion andreae	+	+	+	+	+	
Bembidion atrocoeruleum	+	+	+		+	
Bembidion decorum	+					
Bembidion femoratum			+			
Bembidion monticola	+		+			
Bembidion prasinum	+			+	+	+
Bembidion punctulatum	+		+	+	+	+
Bembidion. testaceum	+ (2)				+ (2)	+ (1)
Bembidion tetracolum		+				
Bembidion tibiale	+	+				+
Lathrobium angusticolle	+	+				

25.8.04

Site Visits to Rivers Tyne and Derwent: 25.8.04

Staff: Dave Bell

Note: No specimens of BT found.

Weather: warm with showery drizzle (some heavy).

River Derwent

Axwell Park records of Bold from 1855 (in NGR square NZ1961).

Walked from NZ 188 611 to NZ 198 623: No suitable habitat on this stretch of the Derwent, banks heavily vegetated right down to water's edge (see all photos). No sand or gravel visible at all, though water levels were high. Normal tidal limit begins at Site 3 (NZ 193 615) – presumably therefore the records originate from either upstream of this point or in flood refuse washed down from upstream. However, today the area upstream is heavily wooded and anecdotal evidence (from a chap who spent much of his childhood in and around the upper parts of the Derwent) suggests that, in any case, there is no river shingle in these areas. Furthermore, huge changes are likely to have occurred in the last 150 years – this stretch of the Derwent is virtually suburban now – with increased housing, industrialisation etc and also the nature of the river has probably changed significantly. No searches undertaken. No BT.

Site 1 (NZ 189 613) – Photo x2
Site 2 (NZ 192 614) – Photo x2
Site 3 (NZ 193 615) – Photo x1 (Dam Head)
Site 4 (NZ 193 617) – Photo x2
Site 5 (NZ 197 621) – Photo x1 (Outside of original record square NZ 1961)
Site 6 (NZ 198 623) – Photo x2 (Outside of original record square NZ 1961)

River Tyne

Weather: warm with showery drizzle (some heavy).

Ryton Willows records of Bold from 1855 (in NGR square NZ1564).

Walked all around the "Ryton Willows" site, now effectively a country park (see photos of information boards). River Tyne at this point is tidal, with the normal tidal limit several kilometres upstream. Presumably, therefore, the records pertain to flood refuse washed down from upstream, or from the ponds that are in this area (which were perhaps recently excavated in 1855). These ponds are the only water bodies (apart from the River Tyne) within the NGR square which houses the original records. In any case, there is no suitable habitat for BT at this site today, either on the banks of the Tyne or at the pond edges. No searches undertaken. No BT.

"Country Park" information boards – Photo x2

Site 7 (NZ 151 650) – Photo x2 (River Tyne)
Site 8 (NZ 157 649) – Photo x2 (Gut Pond)
Site 9 (NZ 155 649) – Photo x2 (Curling Pond)

Worcestershire and Wales - 2.9.04

Site Visits to Rivers Usk and Teme: 2.9.04

Staff: Dave Bell, Jon Sadler & Adam Bates

Weather: Warm, intermittent high cloud.

River Usk

Llangibby Bottom A. (ST 38528 96626). Now rather vegetated (see photos), even in comparison to July visit, particularly near water edge. All BT found just downstream of July records, but still in same part of the bar. Many other areas of the bar's margin were silt covered, presumably due to recent flood events and resultant backing up of freshwater from the tidal limit. All BT also found in the least vegetated areas of the bar. Photos taken of the general area of BT records, plus photos of exact areas of substrate in which BT was found. Sample taken. Photos x9 BT x3.

Immediately downstream of Llangibby Bottom A at ST 385 963. Steep clay cliff with narrow band of shingle (over sand) at river margin. RHB. Cliff face and cliff base searched. Many specimens of BT found, both in crevices in cliff face and amongst shingle at the river edge. Sample taken. Photos x10 BT x13.

Llangibby Bottom B (ST 38809 95289). Virtually whole margin of bar covered in layer of silt (see above description of Llangibby Bottom A). Brief search undertaken but no BT (or other spp.) found. Photos x13

River Teme

Shelsey Beauchamp (SO 72870 62758). River too high to work on – bare shingle at this site completely covered. No searches undertaken, no BT. Photos x4

Other species encountered during searches

Species	1	2
Bembidion atrocoeruleum	+	+
Bembidion decorum	+	+
Bembidion fluviatile		+
Bembidion properans		+
Bembidion punctulatum	+	
Bembidion quadrimaculatum		+
Bembidion testaceum	+	+
Bembidion tetracolum		+
Heterocerus fenestratus		+
Lathrobium multipunctum		+
Neobisnius prolixus		+
Perileptus areloatus		+
Stenus biguttatus		
Stenus bimaculatus		+
Stenus boops		+
Stenus guttula		+

Site Codes:

1. Llangibby Bottom A (Usk)
2. Llangibby Bottom A Cliff (Usk)

23.9.04

Site Visits to Rivers Usk and Teme: 2.9.04

Staff: Dave Bell, Jon Sadler & Adam Bates

Note: No specimens of BT found.

Weather: Cool, bright, sunny with intermittent cloud.

River Devil's Water

Site 1. (NY 975 643). Search undertaken, sample taken, no BT. Photos x4

Site 2. River Devil's Water at Dilston Road Bridge (NY 975 635). No searches undertaken. Photos x3

River Tyne

Confluence – Tyne's Watersmeet. (NY 918 660). Opposite where the South Tyne empties into the North Tyne. Search undertaken, no sample taken, no BT. Photos x2

River South Tyne

Beltingham D/S Site. (NY 790 642). No BT previously found at this site (during the current survey). U/S site (where BT was recorded in August) was inaccessible due to high water levels. Search undertaken, sample taken, no BT. Photos x2.

Other species encountered during searches

Species	1	2
Agonum albipes		+
Bembidion andreae		+
Bembidion atrocoeruleum	+	+
Bembidion decorum		+
Bembidion lampros		+
Bembidion tetracolum		+
Bembidion tibiale		+
Leistus rufomarginatus		+
Ochthephilus omalinus	+	

Site Codes:

1. Dilstonheugh (Devil's Water – Site 1)
2. Beltingham D/S (South Tyne)