Annual Interim Report R&D Project 346

PHYSICAL ENVIRONMENT FOR RIVER INVERTEBRATE COMMUNITIES

University of Leicester

R&D 346/2/A March 1992

ENVIRONMENT AGENCY
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Physical Environment for River Invertebrate Communities

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CONTENTS

SUMMARY

This report describes the progress of NRA R&D Project 346 between 1-4-91 and 31-3-92. Attention is drawn to progress reports which have been submitted to the Project Leader and Steering Group, particularly NRA Interim Report 346/1/A.

The prior reports contain material which has not been duplicated in full for this document. There are no completed additional items but continuing items which have not been the subject of previous reports are summarised. The logical end of the first phase of the project is June 1992, which marks the beginning of fieldwork. Completed items, especially literature reviews, will be reported in full at that time.

The two primary targets for 1991-1992 have been collaborative development of a best strategy, and a review of relevant literature. The latter item has addressed species-habitat relationships, approaches to habitat classification, methods of multivariate analysis, and a general view of the physical context for habitat conservation measures.

The classification procedure which has been used previously on the project (Indicator Species Analysis – Hill *et al.* 1975, Hill 1979) was modified for use on the Apple Macintosh computer. This will improve the efficiency of storage and analysis of data, which to date have been transported between microcomputer and mainframe.

Reference databases compiled for R&D 346, 291 and 526 have been stored on the Apple Macintosh using the application EndNote. The contractors and Paul Biggins (Anglian Region) have been able to transfer information on a trial basis from EndNote to the Anglian Region INFO package. Shortly all reference libraries from the three projects will be available for PC users in the INFO format.

Two papers have previously been published which cover the earlier results of the research (Smith *et al.* 1990, Harper *et al.* 1991). A third paper was presented at an international workshop on lowland stream restoration and has been submitted for publication.

The contractors have been involved with preparation of a functional habitat enhancement scheme for the River Welland. Continued participation as a part of R&D 346 has been approved by the Steering Group, as a field trial of the functional habitat approach. Together with NRA engineers, a 'case study' approach to documentation and post-project appraisal is being developed.

A provisional schedule is presented for the second year of the project, expanding on the targets and timescales set out in the Project Investment Appraisal. It is possible that the schedule will be modified after discussion with the Steering Group and regional contacts.

KEY WORDS

Invertebrates, habitat, classification, conservation, rivers, bibliography, survey

1. PROJECT DESCRIPTION

1.1 Background

Practising river managers frequently recognise the importance of habitat diversity as an explicit goal for conservation measures, not only in the riparian zone but in the channel itself. This development is reflected in the activity of those engaged in basic research with respect to the riverine environment.

New developments in river corridor survey methodology pay particular attention to habitats as visible indicators of conservation status. Recommendations for maintenance of valued sites, and restoration of degraded sites, are readily made in terms of physical habitat. Such recommendations can be compared clearly with flood defence requirements, fostering the partnership of conservation and engineering functions. Habitats are of particular value for macroinvertebrate conservation, where the correct measures for care of individual species are often not known.

Water quality assessment has progressed beyond biotic indices, to use the more specific information offered by RIVPACS. As new data becomes available, and if this is incorporated into the model, there should be a progressive improvement in precision. Full use of community prediction as a tool for water quality investigation requires a clearer understanding of the effect of habitat than we have presently. This will make the effects of water quality and physical habitat distinguishable, leading to management which is most appropriate for each situation.

A greater understanding is required of relationships between macroinvertebrates and their habitats - as a positive tool for river conservation and as a confounding factor in water quality indication. We should aim to be able to –

- Assess objectively the current state of the river with respect to habitat.
- Have quantitative regard for the effect of habitat when using community predictions.
- Present effective, realistic recommendations for habitat management.
- Assess objectively the outcome of the preferred management.

1.2 Context

The NRA is carrying out major programmes of research and development in river survey, enhancement and post-project appraisal. This project aims to further our ability for conservation below the water level, with relevance to each of those three stages. Anglian Region operational investigation (A13-38A) established a working method for objective determination of macroinvertebrate habitats. The present project broadens the scope and value of the initiative in two main ways –

- Consideration of rivers on a national basis. It is important to develop application of the principles developed in A13-38A, beyond lowland rivers in the Anglian Region.

- Recognition of the influence of water quality on the aquatic community, integrating with the other elements of NRA R&D in a unified approach to river management.

Both internal reports and scientific publications accompany the previous work and its applications to rivers in the Anglian region. These are available from the Project Leader.

1.3 Objectives

1.3.1 Overall

To expand and develop a unified method for the ecological assessment of water quality and conservation by 'functional habitat' analysis.

1.3.2 Specific

1. To relate macroinvertebrate abundance and diversity to the nature and richness of the various channel substrates found in British rivers.
2. To broaden the scope of the habitat investigation carried out as part of the existing project with respect to macroinvertebrate 'functional habitats'.
3. To consider together the roles of habitat availability and chemical water quality in structuring the macroinvertebrate community.
4. To compile a draft methodology which addresses river macroinvertebrate conservation through attention to the availability of habitats.
5. To proceed with preliminary trials as part of the development process for the draft methodology.

1.4 Targets for year 1991-92

1. Liaison with Regional Biologists and Conservation Officers over Project achievements to date and proposed development.
2. Collaborative selection of representative rivers of appropriate geomorphology and water chemistry.
3. Initial survey of the selected rivers to confirm their suitability in terms of access and habitat replication.
4. Literature review with respect to macroinvertebrate species-habitat relationships, in order to place the applied value of the work within the wider context of ecological knowledge.

2. STRATEGY DEVELOPMENT

Replicated samples from a wide range of habitat types are required for the initial determination of functional habitats; and the macroinvertebrates must then be identified to species level wherever practical. Therefore it is not feasible to implement a broad national survey/ sampling programme, in contrast to whole-site river classifications based on macrophytes (Holmes 1983 *et seq.*) or macroinvertebrates (Wright *et al.* 1984 *et seq.*). Those classifications do, however, form a basis from which to select reaches which represent common 'river types'.

2.1 Selection of study reaches

An analysis of the sampling and sorting/identification time associated with functional habitat determination showed that around 8-10 reaches could be studied in the second year of the project. Either of the national classifications could be used to select representative reaches, but there are several reasons for preferring the macroinvertebrate-based alternative –

1. The river classification will be increasingly familiar to NRA end-users through water quality assessment using RIVPACS.
2. A substantial body of supporting data, referable by river-type, will become available.
3. Invertebrate-based river types are intuitively preferred by the prospective end-users.
4. Whilst the Nature Conservancy Council (1989) produced a ten-group summary of Holmes' classification, his detailed distinctions between the original 56 types are hard to ignore.

The project strategy is summarised in Figure 1. Ten reaches were chosen to represent the most frequent river types of Wright *et al.* (1984), after consultation with the Biologists and Conservation Officers from several regions. Table 1 lists the sites upon which the reaches are based – for each river type, a series of at least three contiguous sites.

It was originally intended to exclude upland river types with a lesser routine management regime. This qualification was not eventually made, since the ten commonest river types constitute over 90% of the sites used in the classification.

2.2 Preliminary surveys

A preliminary survey was carried out over each of the prospective study reaches during September and October 1991. The intentions were as follows –

- Note the range of potential habitats over the reach by a broad survey at access points.
- Locate several examples of each habitat, which may be reproducible in 1992.
- Find a range of access points and anticipate problems of access.
- Discover and address any other problems, in advance of the 1992 fieldwork.

An example of preliminary survey results, for the River Smite in Severn-Trent Region, is given as Appendix A. Three days have been scheduled for fieldwork at each of the study reaches in summer 1992. The first day at each reach, where necessary, will be spent confirming access and setting a detailed plan for sampling.

So long as reach selection corresponds to the river types, there remains some flexibility. Flows in the River Mimram were very low during 1992 and discussion with local residents suggested that the river had been almost ephemeral in recent years. After another dry winter it is likely that one of the other clear representatives of the river type will be preferred, namely –

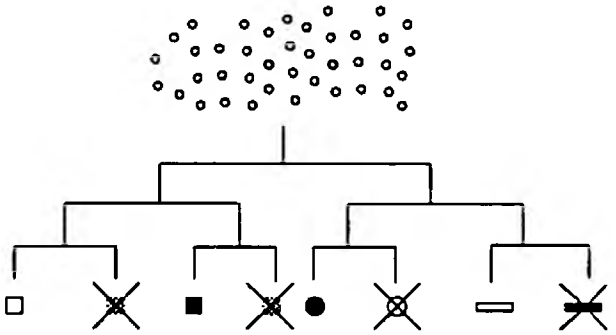
River Evenlode (SP 202 312 - SP 20 281 - SP 274 197)

River Leadon (SO 697 404 - SO 701 332 - SO 730 307 - SO 770 270)

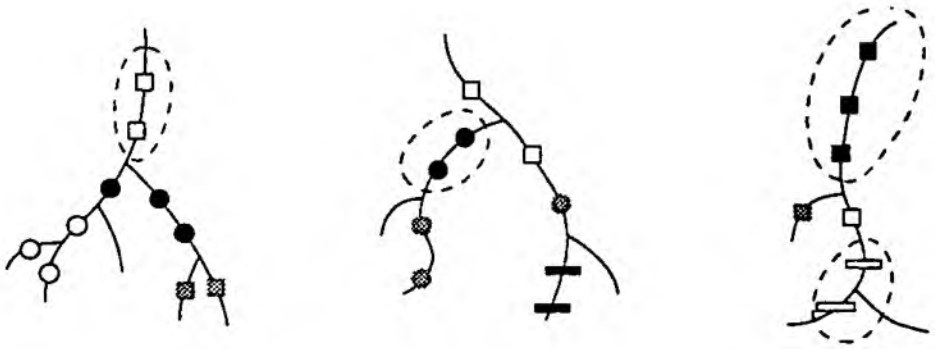
Table 1 List of reaches which represent the ten most frequent river types defined by Wright *et al.* (1984).

Type	River	O.S. Grid Reference				
17	Dove	SK 084 665	SK 121 598	SK 146 504		
18	Swale	NY 885 015	SD 933 978	SE 046 985	NZ 146 007	
19	Wansbeck	NY 996 844	NZ 053 842	NZ 119 850		
20	Torridge	SS 324 178	SS 399 126	SS 470 061	SS 542 064	
21	Teifi	SN 684 628	SN 642 547	SN 523 454	SN 373 403	SN 217 437
22	Itchen	SU 523 325	SU 481 282	SU 470 233		
24	Y. Ouse	SE 467 621	SE 556 552	SE 591 455		
25	H. Avon	SU 163 174	SU 149 035	SZ 158 933		
26	Mimram	TL 193 207	TL 208 180	TL 282 134		
27	Smite	SK 690 262	SK 697 333	SK 773 427		

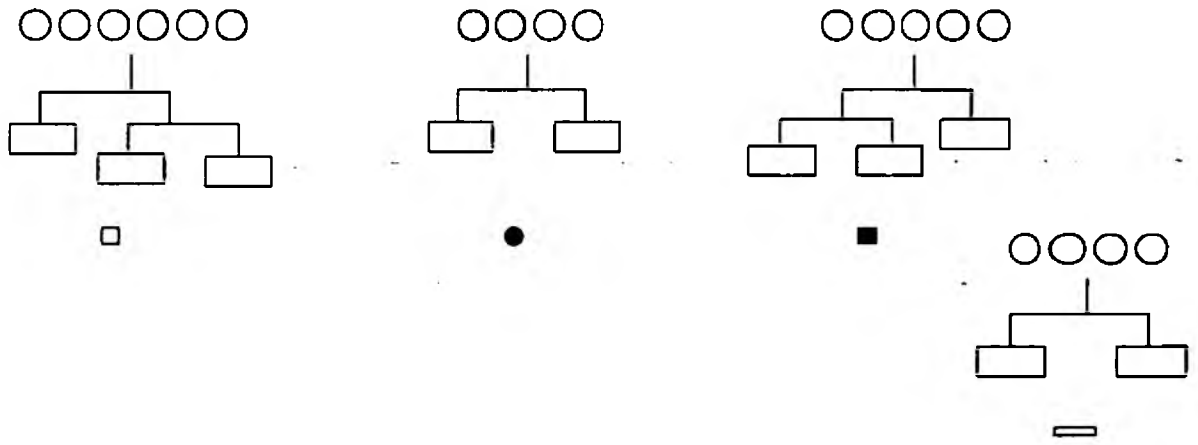
1. Select the most frequent river types from the classification of Wright *et al.* (1984).



2. Select reaches in England & Wales to represent the river types.



3. Carry out a functional habitat classification for each reach (river type).



4. Use the functional habitat information for differing river types to prepare a draft methodology for the use of functional habitats in conservation management.

Figure 1 Strategy towards preparation of draft methodology

3. LITERATURE REVIEW

A search and review of literature on several topics has been the main item of work during the period since Interim Report 346/1/A.

The Steering Group decided that the bibliographies of R&D Projects 346, 291 & 526 should be made available on Anglian Region's INFO database management package. The contractors and Paul Biggins (NRA Anglian) have developed a method for transfer of information from the contractors' preferred literature database (EndNote on Apple Macintosh) to INFO on IBM-compatible PCs. Test files have been transferred successfully, so the full bibliographies should become available for INFO as soon as they are in a final form, with subsequent updates.

3.1 Species-habitat relationships & habitat assessment methods

These were described as separate items of future work in Interim Report 346/1/A. The nature of published information has meant that it is more useful for the present time to merge them as one target for literature review. Specific needs of R&D 346 (*ie* existing approaches to habitat assessment) will then be pursued in greater depth.

The 'final quality' output for this item is required for late April, since it also forms an integral part of R&D 291 (Riparian and Instream Species-Habitat Relationships) as discussed at the third meeting of the joint steering group. A summary of the work to date has not been prepared for this report (*cf* § 3.2 & § 3.3) so that more time is available for completion, and for adjustments to correspond to the Final Report format of R&D 291.

3.2 Classification method

A search of recent literature has been carried out, to locate the work of others who have used indicator species analysis and similar methods of classification. There are four main issues which this item of work addresses –

1. Selection of abundance categories, termed 'pseudospecies'. Log_{10} categories (0-9, 10-99, *etc*) have been used in this project to date, but alternatives based on the abundance frequency distribution are under consideration.
2. Objective identification of outliers. Many of the results to date have been clear but we need an objective method for dealing with less straightforward cases such as the Welland submerged macrophytes.
3. Alternative classification methods. The widespread use of indicator species analysis as a classification method is partly influenced by its availability as the computer program TWINSPAN. Whilst strong reasons will be required to change the method at this stage, alternatives are under review.
4. Third-party comment. Preliminary liaison with regional personnel showed the value of comment from sources other than the contractors and steering group. Where the published details of a method are not complete, we are making direct enquiries with the

authors. They may well make suggestions which improve our approach to classification of habitat data.

A summary of the current reference database is given as Appendix B. Presently, about 20% of the references have been followed up by consulting the publication and soliciting further information from the authors where necessary. The target is to follow up a majority of the references before the start of fieldwork in June 1992. There is no intention to extend the basic search but relevant material will be added, as it is encountered independently or from entries in the current list.

3.3 Physical perspective

There is an onus on both conservationists and engineers to be aware of key issues which affect the other's priorities for river channel management, leading to recommendations which are realistic and provide a firm basis for the preferred option. This need for inter-disciplinary awareness is beginning to be met explicitly in the literature (*eg* Gardiner 1992, Gordon *et al.* 1992), and in the NRA through recognition of engineering and conservation as a partnership.

The draft methodology for functional habitat assessment should ensure that all relevant information is gathered during the habitat survey and desk study, with no further planned fieldwork requirement prior to consultation. This will require the survey to have regard for physical controls of channel morphology; the requirements of flood defence; and the range of likely options for channel design and maintenance. There are a number of texts which start with the basics of geomorphology and stream hydraulics.

Practical application of principles to river management often requires further reference, whilst contemporary information is particularly necessary for conservation-oriented themes such as channel restoration and instream flow requirements. The schedule for field and laboratory work for the second project year means that time after May 1992 is at a premium. A broad collection of contemporary references in the engineering literature has therefore been made in advance, for study of particular topics when necessary. The list is summarised as Appendix C.

The bibliography is at present usually limited to the references themselves, and is based primarily on publications of the American Society of Civil Engineering. During the course of the project other items will be added, and an increasing proportion of references will be annotated. Topics which are especially relevant will then be reviewed in detail, to accompany the functional habitat methodology.

4. SUPPLEMENTARY ITEMS

In addition to the primary targets for 1991-92, there have been other items of work, either complementary to the project or preparatory for the second stage. At the present time these are lesser priorities than the species-habitat literature review (§ 3.1), which is required for the end of April 1992.

4.1 Welland restoration project

A scheme for habitat enhancement on part of the River Welland is being developed by Anglian Region. Preliminary recommendations were submitted to the Regional Conservation Officer and were discussed in Interim Report 346/1/A. Full documentation of the scheme and post-project appraisal has been recognised as a major requirement, and it has been agreed that the contractors to R&D 346 will continue to provide input.

4.2 Promotion of work

In conjunction with the Project Leader, a presentation was made at an international Workshop on Lowland Stream Restoration in August 1991. The manuscript has been submitted to Freshwater Biology, and was appended to Interim Report 346/1/A with further discussion of the Workshop (Lund, Sweden).

4.3 Species identification

The identification of some taxa, notably among larvae of Diptera, has to now been left at the family level. A review of the literature has been carried out for several groups (*eg* Psychodidae, Tipulidae, Tabanidae) and enquiries are being made with the appropriate specialists. Hydracarina are abundant in most rivers but are usually passed over in studies of stream ecology, since little basic information on their identification is available. The literature suggests that identification to a further level should be no more difficult than for, say, early nymphs of *Baetis*. A working guide for some further identification of Hydracarina is in preparation.

It is important to make best use of the time in autumn/winter of 1992 which is scheduled for identification. Practical keys are unavailable for some groups, or cover a much greater range of species than those expected from British running waters. In these instances, working guides are in preparation, which are intended to make identification more efficient. For example, the comprehensive guide to Holarctic genera of Tanypodinae (Chironomidae) given by Fittkau and Roback (1983) has been abbreviated to include only those genera feasible from British running waters (Appendix D).

Preparation of guides for identification will continue amongst other tasks, with the aim of completing most before commencement of fieldwork in June 1992. The guides will be annexed to Progress Reports as they are completed.

4.4 Preparatory work

The time available for fieldwork and sample processing are both restricted. It will be advantageous to take samples from the different study reaches within a short period, so that comparisons between river types are valid in the face of seasonal community changes. Sufficient time is required at the end of the second year for proper analysis of the results, which means that time for sample sorting and species identification is about 5 months. There are several ways in which the field and laboratory work are to be made efficient –

1. Preparation of simple guides to identification, where necessary (see § 4.3)
2. The budget for 1992 includes an element for employment of a summer assistant. We have an honours student with excellent experience who will be available to sort and process samples.
3. The reaches will be prioritised for sampling. Upland rivers will be visited last, to reduce the loss if sampling takes longer than expected.
4. Species groups will be prioritised for identification. Those groups which take longest to prepare and identify will be left to the end of identification. Then if time runs short, a substantial basis for the draft methodology will still be available, returning later to groups such as chironomids.
5. Data sheets and computer file storage for the data have been set up. A detailed procedure for data analysis is in preparation, subject to results of the methodological review described in § 3.2.

5. FURTHER WORK

5.1 Targets for 1992-93

The Project Investment Appraisal set out the following target for the second year of the project –

> Detailed desk study and field survey of the chosen study reaches. Multivariate analysis of macroinvertebrate distribution between 'potential' habitats leading to the determination of 'functional' habitats. [31 March 1993]

There is a possibility of work in Spring 1993 towards the next target set out in the PIA, namely –

> Production of draft 'Standard Methods' handbook for habitat analysis of rivers and discussion with regional contacts. Report to be submitted to Water Quality Survey Group for comment and input. [30 June 1993]

5.2 Timescale

A provisional timetable has been drawn up for discussion with the Steering Group and modification according to regional preferences.

Fieldwork	Smite	June
	Mimram (see § 2.2)	
	Torridge	
	Wansbeck	
	Teifi	July
	Itchen	
	Avon (Hants)	
	Ouse (Yorks)	
	Dove	
	Swale	
Identification		August-December
Analysis		January-February
Report preparation		February-March
Annual Report (including full data as annex)		31 March 1993

Times for identification and analysis are quite likely to be underestimated and overestimated respectively. Prioritisation of taxa for identification will ensure that a meaningful dataset is obtained in the time available. If analysis is brief, this may leave time at the end of the year to commence preparation of the draft methods handbook.

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24-3-1992

Geoff Brighty
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Peterborough PE2 0ZR

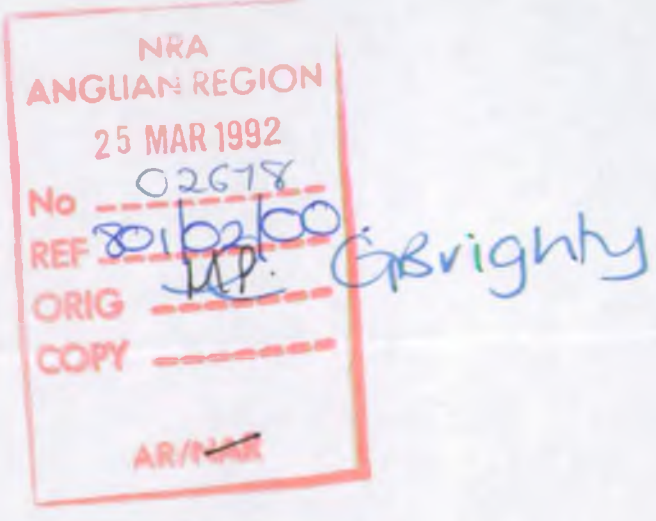
Dear Geoff,

Please find enclosed the Annual Interim Report for R&D 346. Technically I suppose it's a draft, but I bound it as a final version to save time if there are no major changes to be made. If this turns out to be a Project Report I'll expand it as necessary to include all I've done to date ... not too chuffed to be unsure if I'm in work this time next Wednesday.

I look forward to talking again at the Steering Group meeting in a week if you can come – and hope I've left enough time for you to go through the report beforehand.

Yours sincerely,

Cath Smith



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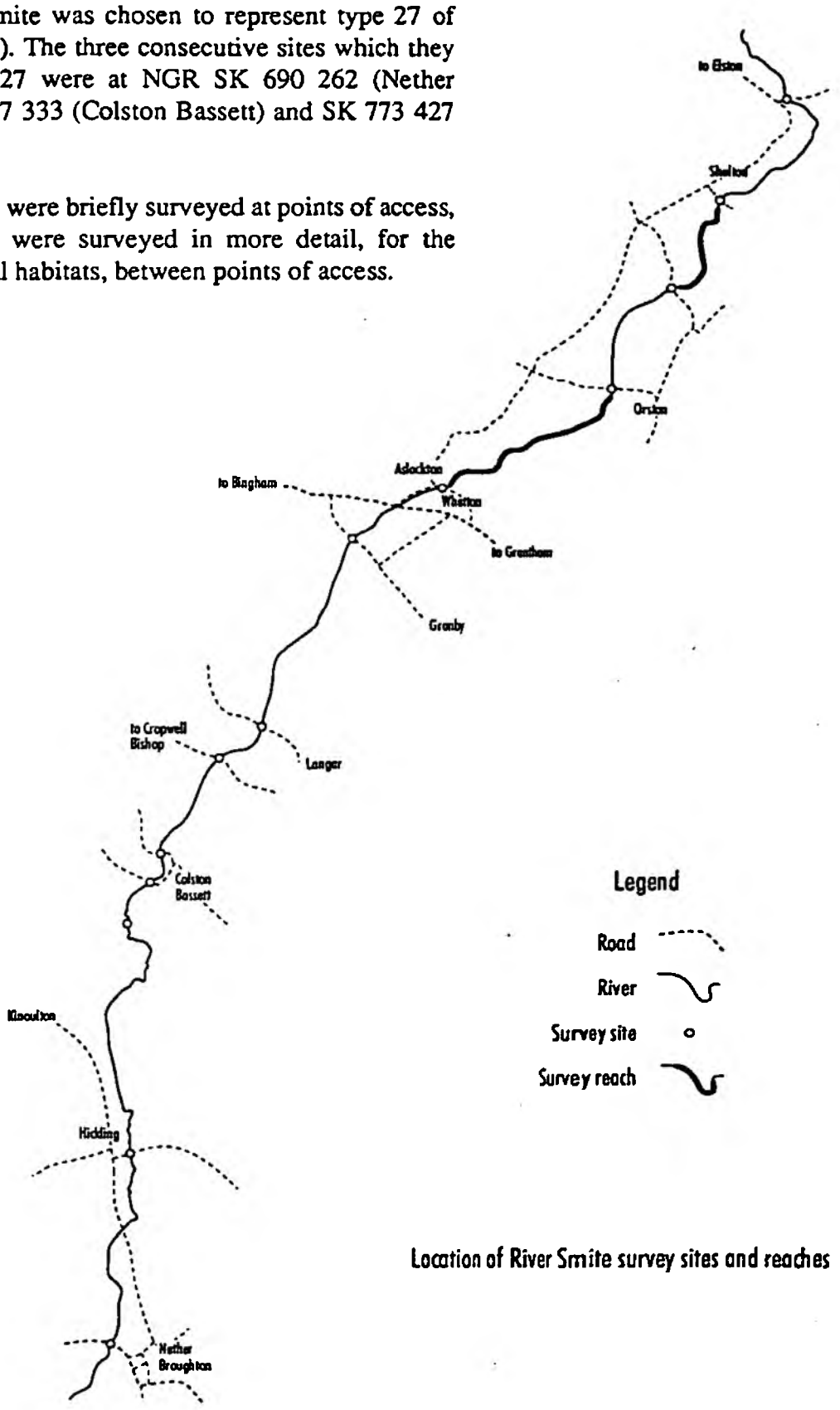
A PRELIMINARY SURVEY – RIVER SMITE

The River Smite was chosen to represent type 27 of Wright et al. (1984). The three consecutive sites which they classified in type 27 were at NGR SK 690 262 (Nether Broughton), SK 697 333 (Colston Bassett) and SK 773 427 (Oscar Bridge).

Thirteen sites were briefly surveyed at points of access, while two reaches were surveyed in more detail, for the location of potential habitats, between points of access.

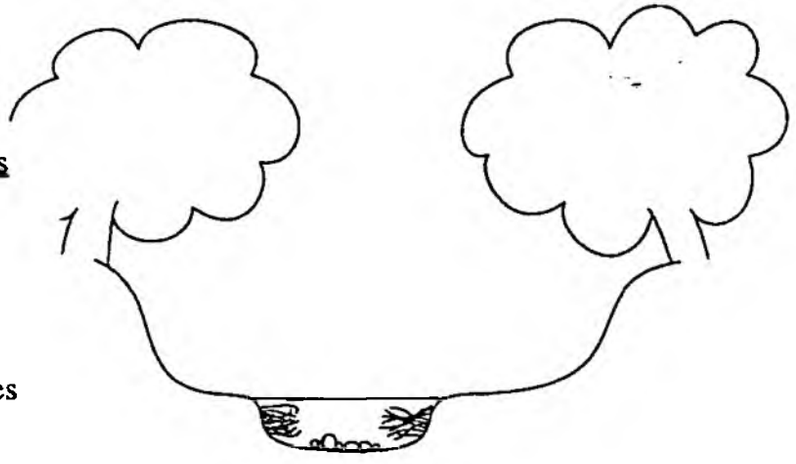


Location of River Smite survey sites and reaches

1 Site surveys

1.1 Nether Broughton (SK 690 261)

Upstream



- Gentle bend to RHB
- Stone / gravel / sand / roots
- Riffle - pool system
- Width 1 m
- Depth 0·1 - 0·3 m
- 0·1 - 0·3 ms^{-1}

- No submerged macrophytes
- Some tiny *Myosotis*

- Both banks 80 - 90 % *Fraxinus* / *Crataegus* / *Salix* ... often at edge of channel

- Access OK both banks

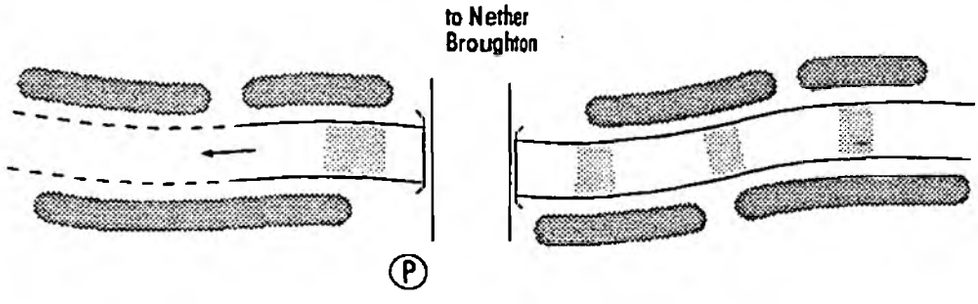
Downstream

- Straight (not visible very far)
- Stone / gravel / sand
- Gravel riffle immediately below bridge ... 0·2 ms^{-1}
- Width 1 - 2 m
- Depth 0·1 - 0·2 m

- No submerged macrophytes
- Some overgrowing *Urtica* / *Rubus*

- RHB 70 % *Fraxinus* / *Crataegus* / *Prunus*
- LHB 80 % *Fraxinus* / *Crataegus*

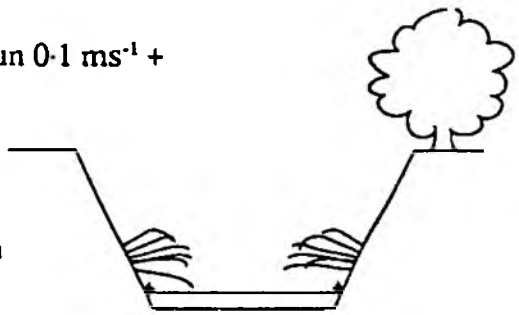
- Access OK LHB ... nil RHB



1.2 Hickling (SK 694 289)

Upstream

- Straight
- Stones / gravel / clay
- Weak riffle for 3 m above bridge ... otherwise run 0·1 ms^{-1} +
- Depth 0·2 m
- Width 1 - 2 m



- 30 % *V. beccabunga / Myosotis*
- 100 % *Urtica / Epilobium / Solanum* overgrowth

- RHB 90 % *Prunus / Crataegus / Fraxinus*
- LHB one each of *Crataegus & Fraxinus*

- Access OK RHB ... nil to water LHB

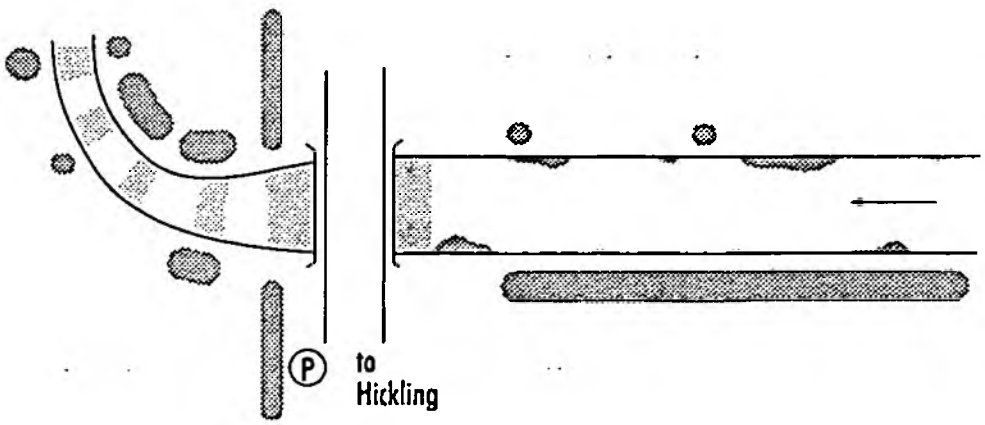
Downstream

- Sharp bend to RHB - obscuring visibility
- Clay / stones
- Depth 0·1 - 0·3 m
- Width 1 - 2 m
- Strongly riffle - pool ... 0·1 - 0·5 ms^{-1} ... like upland stream

- Odd bits of *V. beccabunga / Myosotis / Agrostis*
- Typically 50 % *Phalaris* (little in water) + 50 % *Urtica / Epilobium* overgrowth

- RHB 50 % *Crataegus*
- LHB scattered 10 % *Crataegus / Prunus*

- Access OK but rough



1.3 Colston Bassett u/s (SK 694 325)

Upstream

- Tight bend to LHB
- Slate bed (*cf* Colston Bassett d/s bankside)
- Width 2 - 3 m ... reduced by marginals
- Ponded by bridge ... 0·3 - 0·5 m deep ... < 0·1 ms^{-1}

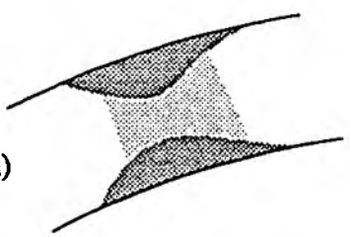
- No submerged macrophytes ... one small clump *S. erectum*
- *Apium / Phalaris* 1 m 50 % ... 2 m 10 %
- *Urtica / Epilobium* overgrowth 80 %

- LHB 100 % *Rubus* ... RHB 5 % *Crataegus*

- Access good RHB ... nil to water LHB

Downstream

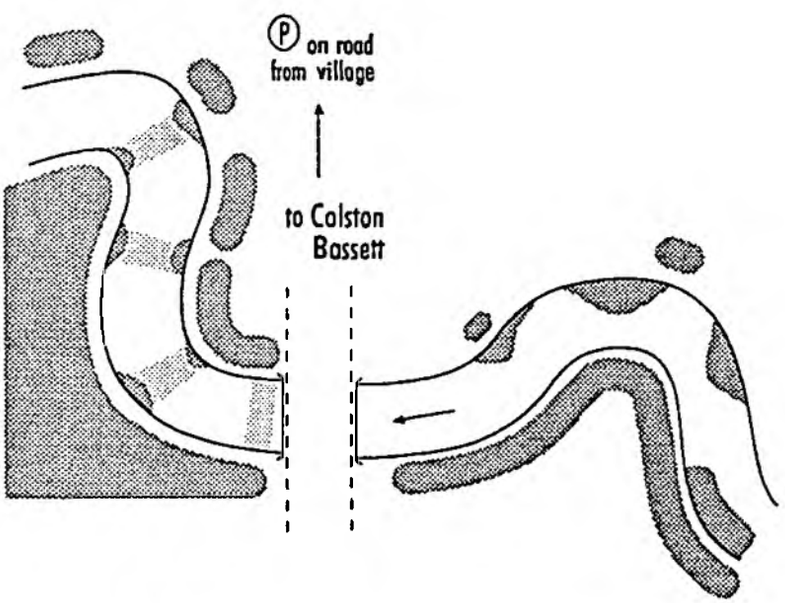
- Tightly meandering
- Riffle system ... slate / slate gravel ... some 'steps' 100 m d/s
- Width 3 - 4 m ... reduced by marginals
- 0·1 - 0·8 m deep ... 0·1 - 0·5 ms^{-1}



- Marginals associated with the slate-derived gravel riffles ... 10 % *Apium / Myosotis / Petasites* (channel there 1 - 2 m)
- Margins 90 % overgrown *Urtica*

- LHB 100 % *Prunus / Fraxinus / Quercus / Crataegus / Symphoricarpus*
- RHB 60 % *Prunus / Crataegus*

- Access good RHB ... nil LHB



1.4 Colston Bassett (SK 697 333)

Upstream

- Gentle bend to LHB
- Gravel / sand
- Depth 0·25 - 0·5 m
- Run ... 0·1 ms^{-1}
- Width 4 m ... reduced by marginals

- Overgrowth of *Urtica* / *Epilobium* 70 %
- 2 m of *Myosotis* / *V. beccabunga* 10 %
- No submerged macrophytes

- RHB 60 % *Fraxinus* / *Crataegus*
- LHB 90 % *Fraxinus* / *Crataegus* / *Acer*

- Access OK

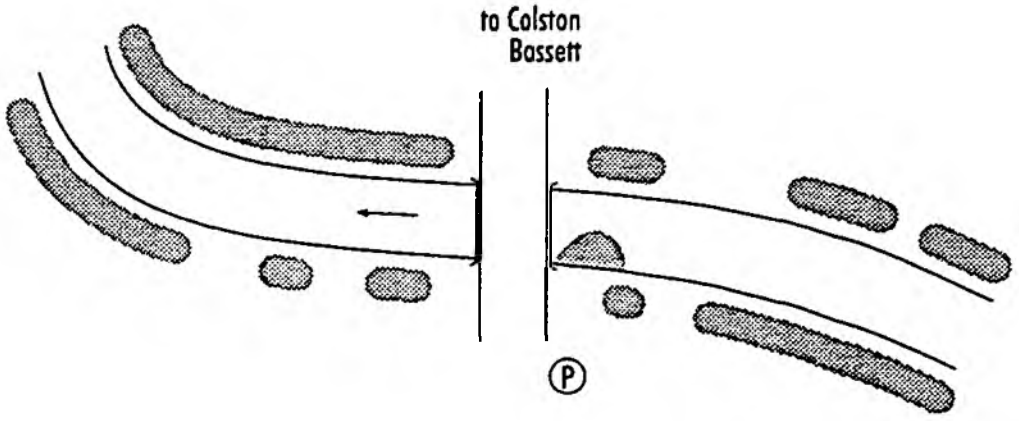
Downstream

- Moderate bend to RHB
- Gravel / sand / stones
- Depth 0·25 - 0·5 m
- Run ... 0·1 ms^{-1}
- Width 4 m

- 100 % thin overgrowth of *Urtica*
- No submerged macrophytes

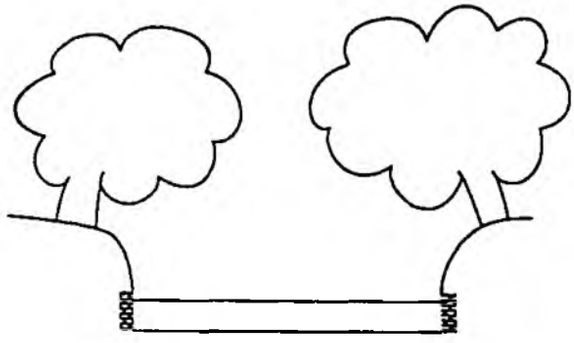
- RHB 100 % *Acer* / *Sambucus* / *Crataegus*
- LHB 80 % *Acer* / *Sambucus* / *Crataegus* / *Salix*

- Access best from u/s through bridge



1.5 Colston Bassett d/s (SK 699 337)

Upstream



- Gentle bend to RHB
- Flow < 0·2 ms^{-1} ... Width 5 m
- Stones / gravel run ... 0·2 - 0·4 m
- Artificial margin of slate / concrete bags ... bed is naturally slate

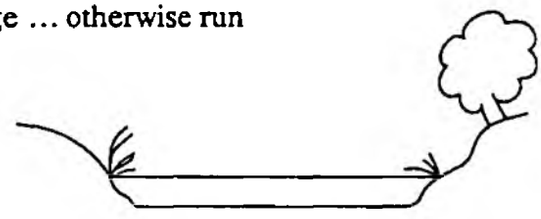
- Margins 10 % overhanging *Urtica* ... otherwise bare
- 20 % thin *Myosotis* etc starts 30 m above bridge
- No submerged macrophytes ... except 1 small patch *Callitriche*

- RHB 100 % Blackthorn / *Crataegus* ... LHB 80 % *Fraxinus* / *Crataegus*

- Access good LHB ... nil to water RHB

Downstream

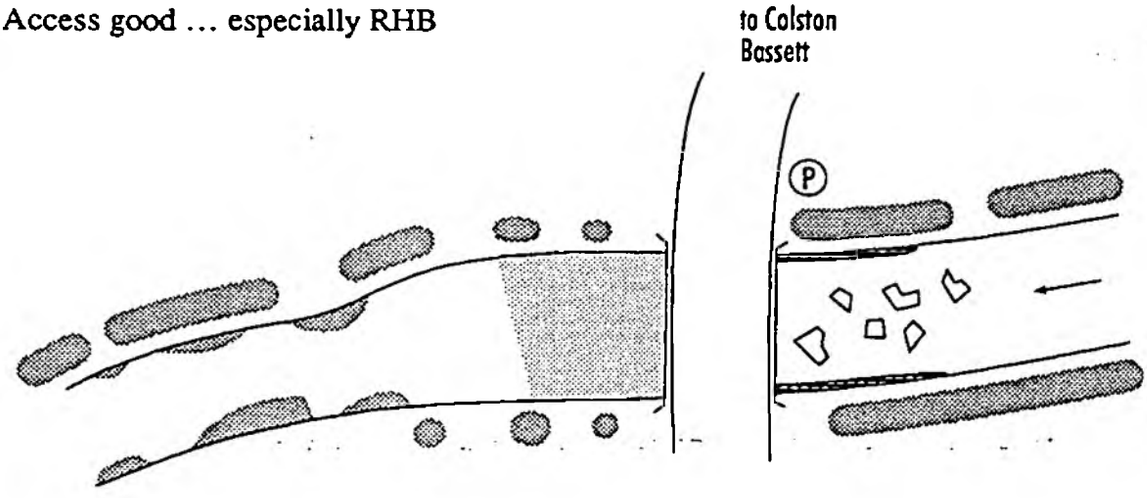
- Width 4 m (some 3 m due to marginals)
- Small riffle of artificial substrate below bridge ... otherwise run
- Slight curve to LHB
- Stones / gravel ... 0·5 m after the riffle
- Flow 0·2 - 0·4 ms^{-1}



- A little *J. inflexus* near NWL
- No submerged macrophytes
- Some margins up to 1 m ... *Myosotis* / *Apium* / *Phalaris*

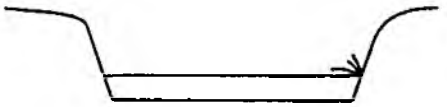
- RHB 70 % *Fraxinus* / *Crataegus* ... LHB 10 % *Fraxinus* / *Crataegus*

- Access good ... especially RHB



1.6 Fernhill Farm (SK 707 350)

Upstream



- Gentle bend to RHB
- Stones / gravel / sand
- Flow 0·1 - 0·2 ms^{-1}
- Width 4 m
- All ponded run ... depth 0·3 - 0·5+ m

- Margin 2 % *Myosotis* / *Phalaris* ... most overgrown *Urtica* / *Epilobium*
- No submerged macrophytes

- RHB 10 % *Crataegus* / *Fraxinus* / *Sambucus*
- LHB 10 % *Crataegus* / *Fraxinus* / *Sambucus*

- Access OK

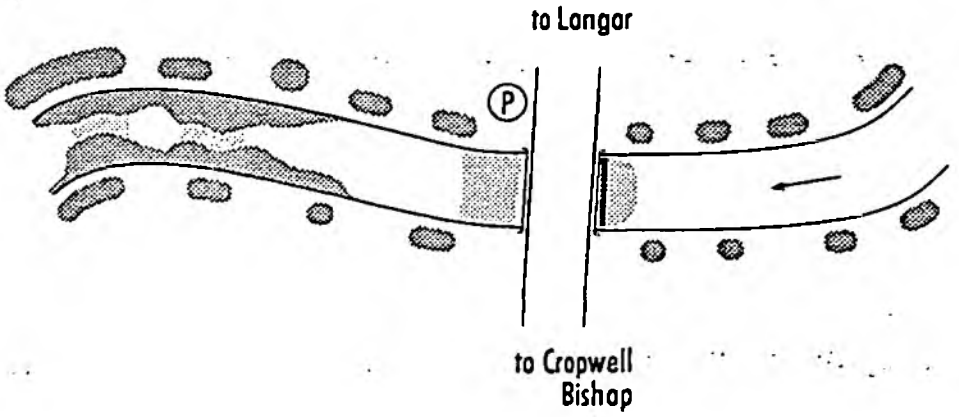
Downstream

- 4 m trapezoidal ... most vegetated to < 1 m (riffles) or 2 m (pools)
- Distinct riffle / pool series
- Moderate bend to LHB
- Stones (many artificial) / gravel / sand
- Depth 0·2 - 0·5 m
- Flow 0·2 - 0·8 ms^{-1}

- No submerged macrophytes
- Margins 80 % *Phalaris* / *Apium* ... 20 % overgrown by *Urtica* / *Epilobium*

- RHB 70 % *Crataegus* / *Sambucus*
- LHB 20 % *Crataegus* / *Fraxinus* / *Acer*

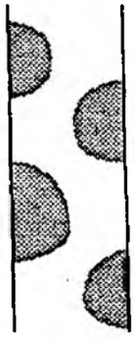
- Access OK



1.7 Wiverton Hall (SK 716 357)

Upstream

- Straight gravel / sand run ... 0·1 ms^{-1}
- Depth 0·2 - 0·4 m
- Width 4 m (1 - 3 m where *Apium*)
- Shallows to 0·15 m with bricks etc under bridge ... effect of sill c. 0·15 m



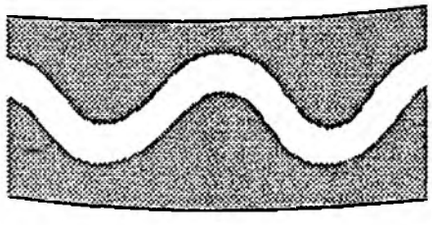
- Margin 70 % overgrown *Phalaris / Urtica / Epilobium*
- Total 30 % invading *Apium* ... starts 40 m u/s at 50 %
- Occasional *Myosotis* but not very visible
- Shading from very steep banks ... some *Petasites*
- No submerged macrophytes

- *Crataegus* RHB 90 %, LHB 30 %

- Access OK LHB ... poor to water RHB

Downstream

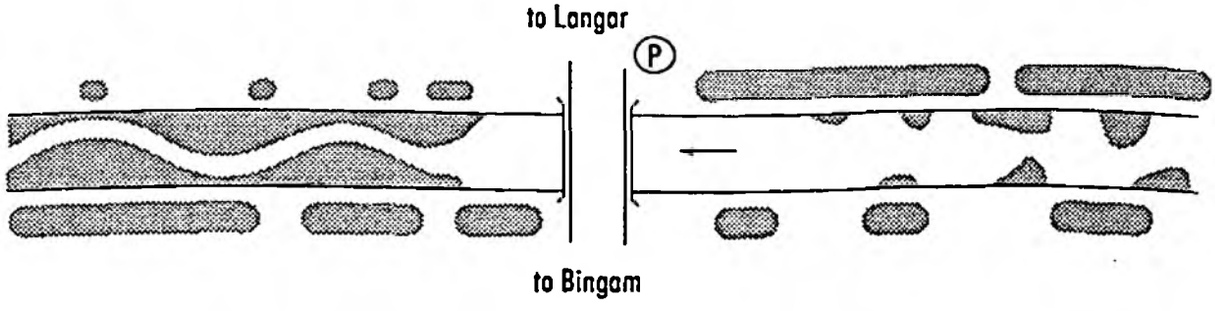
- Width 4 m (mostly to < 1 m with marginals)
- All gravel / sand run but 0·2 - 0·5 ms^{-1} ... may be varied at low flow
- Straight
- Depth 0·2 - 0·4 m



- No submerged macrophytes
- *Apium / Phalaris / V. beccabunga* 100 %
- Small patch *S. erectum*
- One clump (3 - 4 shoots) *T. latifolia*

- *Crataegus* RHB 10 %, LHB 80 %

- Access OK RHB ... poor to water LHB



1.8 Vicars Croft (SK 728 386)

Upstream

- Gravel / sand
- Uniform flow 0·2 ms^{-1}
- Width 5 m (4 m where *Phalaris / Apium*)
- Depth 0·5 - 1 m
- Bridge has one channel at NWL, two others at flood stage
- Ponded, but gravel / sand against sill creating riffle conditions

- Overgrown *Urtica / Epilobium* except 20 % *Phalaris / Apium*
- No submerged macrophytes

- *Crataegus / Sambucus* 20-30 %

- Access OK ... best RHB

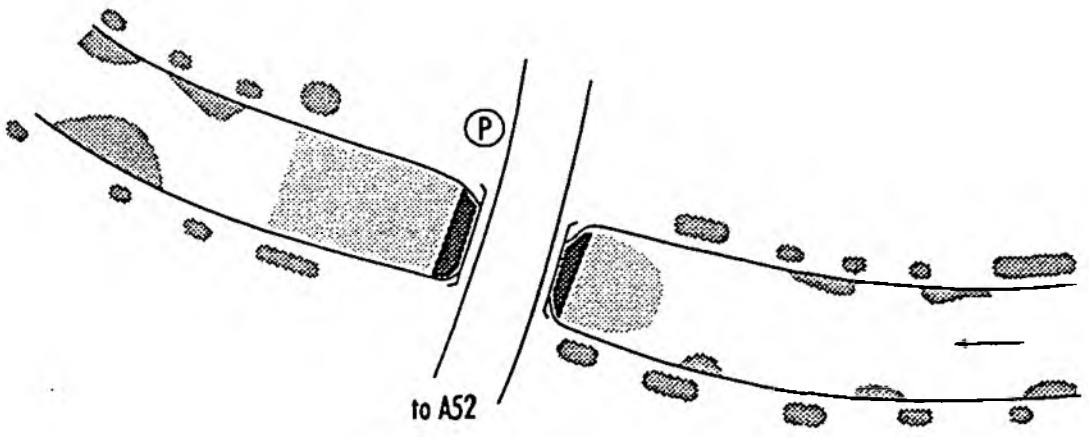
Downstream

- Gravel / sand
- Width 4 - 5 m (mostly reduced to 2 - 3 m by marginal plants)
- Riffle ... largely artificial material ... 5 - 20 m downstream
- ... then run with no further riffles visible
- Uniform depth 0·5 m + and flow 0·3 ms^{-1} except riffle section

- *Phalaris / Apium* 80%
- No submerged macrophytes

- Single *Fraxinus* ... 30 - 40 % small *Crataegus*

- Access difficult



1.9 Whatton (SK 742 395)

Upstream

- Straight
- Gravel / sand
- Uniform flow 0·5 ms^{-1} -
- Width 5 m +
- Uniform depth 0·5 m +

- *Phalaris / Agrostis* margins 50 %
- Some *V. beccabunga*
- *P. pectinatus* 30 % cover

- *Crataegus / Sambucus* 50 %

- Access OK

Between bridges

- Riffle 15 m (mostly artificial material *eg* bricks)

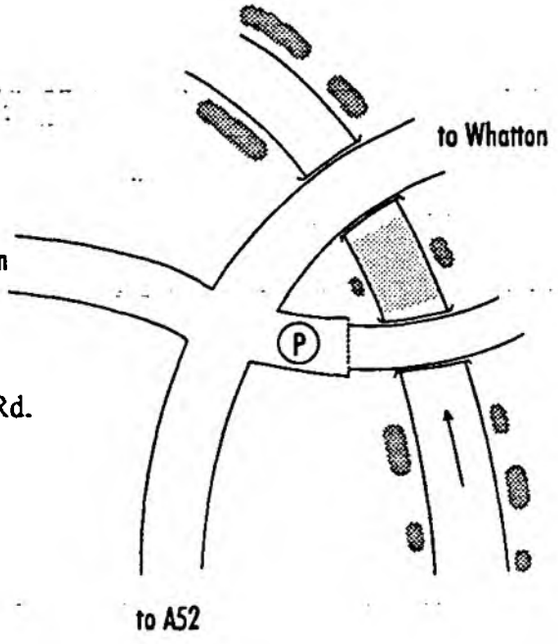
Downstream

- Straight
- Gravel / sand
- Uniform flow 0·5 ms^{-1} -
- Width 7 m
- Uniform depth 0·5 m -

- Some *Apium* in margins, which are mostly *Urtica / Epilobium*
- Two shoals, with *Apium*
- *P. pectinatus* 5 % cover

- *Crataegus / Sambucus* 80 %

- Access to LHB by footpath off Aslockton Rd.
- RHB not accessible



1.10 Orston (SK 765 412)

Upstream

- Straight
- Impounded by bridge foundations ... 0·1 ms^{-1}
- All run ... depth 1 m +
- Sand / gravel
- Width 9 m +

- No submerged or marginal vegetation
- Extensively shaded by riparian tree belts

- *Fraxinus / Acer / Crataegus / Prunus / Quercus* 90 % both banks

- Access excellent both banks ... easiest to water LHB

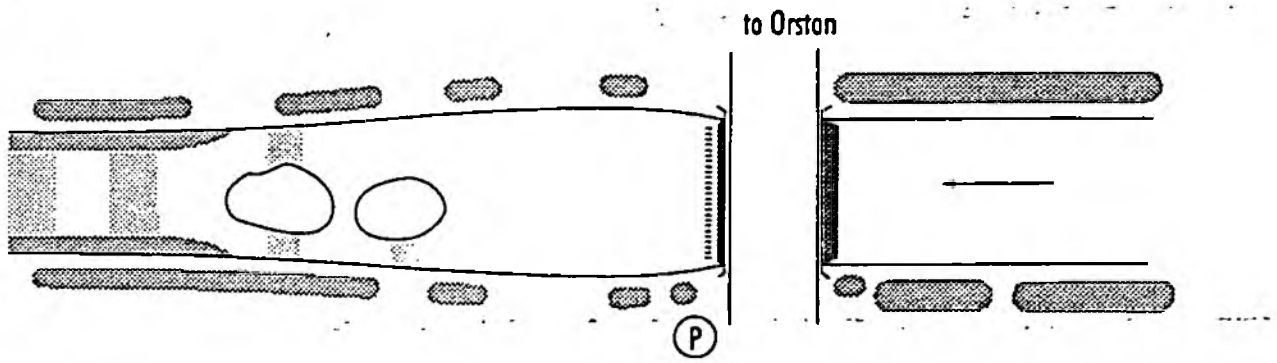
Downstream

- Straight
- Wider part with overgrown shoals
- Riffles on narrow section and beside shoals
- Depth 0·2 - 0·8 m
- Sand / gravel between stony riffles
- Bridge foundation sill 0·3 m drop
- Width 9 m ... narrowing to 5 m after 50 - 100 m

- No significant submerged macrophytes
- 80 % *Urtica / Epilobium* overgrowth
- 50 % *Phalaris / G. maxima* on narrow section
- Shoals overgrown *Phalaris / V. beccabunga / Apium*

- *Crataegus / Acer* 70 % LHB ... 60 % RHB

- Access excellent both banks

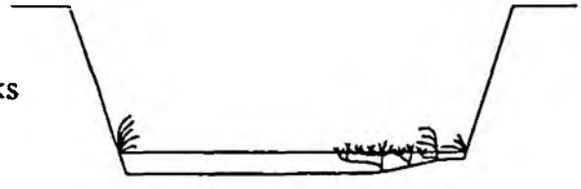


1.11 Oscar Bridge (SK 773 427)

Upstream

- Straight
- Gravel / sand
- Width 5 m (subject to marginals)
- Bridge foundation sill has accumulated u/s gravel
  ... apparent riffle
- All ponded after sill effect
  ... depth 0·3 - 0·5 m u/s

- Margins of *Apium* or *G. maxima* / *Phalaris*
  ... 90 % some ... 20 % extensive
- No submerged macrophytes

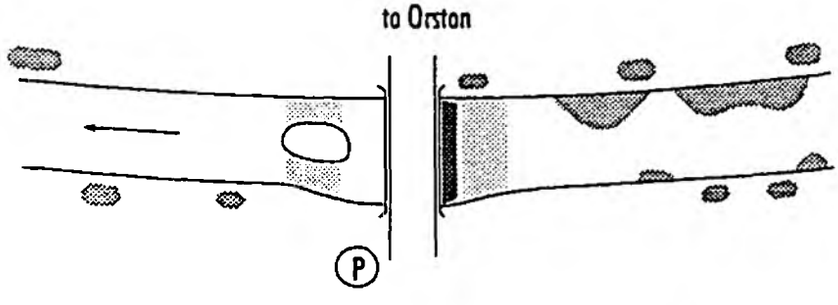


- Occasional (1 - 2 %) *Crataegus* both banks
- Access good

Downstream

- Gently meandering
- Width 8 m for 15 - 20 m ... then 5 - 6 m
- Riffle immediately d/s ... otherwise run
- Shoal midstream in wide section
- Gravel / sand
- Depth 0·2 - 0·5 m ++ d/s

- *Phalaris* / *G. maxima* 50 % ... 0·1 - 1 m
- *Phalaris* / *Apium* on shoal
- Odd *Apium* / *Myosotis*
- No submerged macrophytes
- Occasional (1 %) *Crataegus* both banks
- Access good ... especially LHB



1.12 Shelton (SK 778 442)

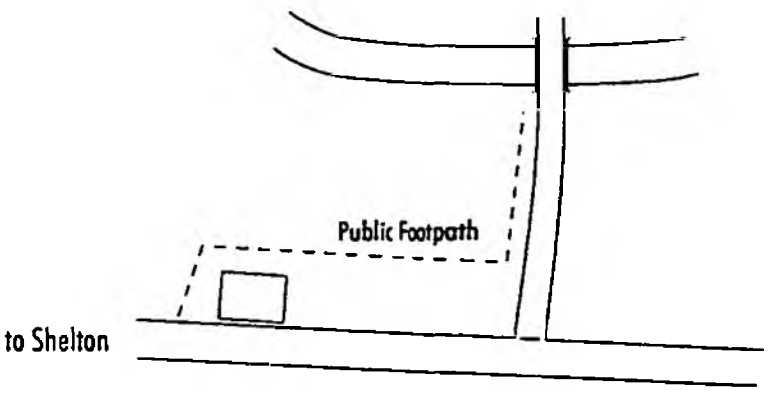
Upstream

- Sill with lot of gravel against it ... relatively shallow & fast
- Width 8 m narrowing to 5 m after 30 m ... all ponded
- Sinuous but distinctively engineered section
- Sand / gravel ... depth 0·5 - 1 m +

- Large stand of *Apium* above central pillar of bridge
- *Phalaris / Apium* 50 %
  ... not invading channel
- A little *V. beccabunga*
- No submerged macrophytes

- RHB bare
- LHB isolated *Crataegus* 2 %

- Access good both banks



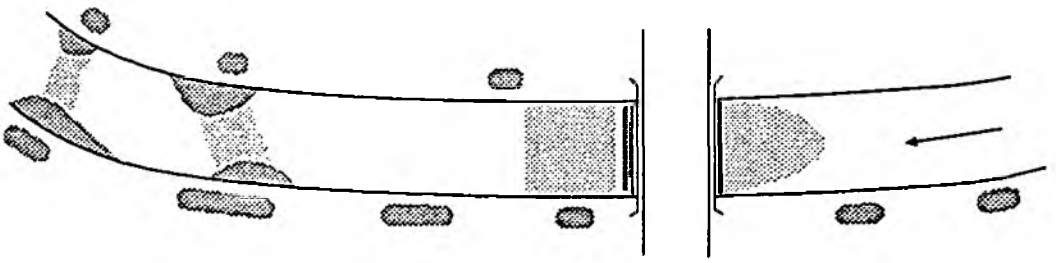
Downstream

- Sill 0·3 m + with some artificial stones below
  ... then run until start of riffle system after 30 - 40 m
- Width 8 m narrowing to 5 m after 30 m (3 m where marginals)
- Riffle section meanders a little within floodway due to marginals
- Sand / gravel ... depth 0·5 m + ... then varying with riffle - pool

- *Urtica / Phalaris / Epilobium* 50 %
- Strong *Apium* 50 %
- No submerged macrophytes

- RHB odd *Fraxinus / Crataegus* ... 1 %
- LHB *Crataegus* 30 %

- Access good both banks



1.13 Wensor Bridge (SK 786 457)

Upstream

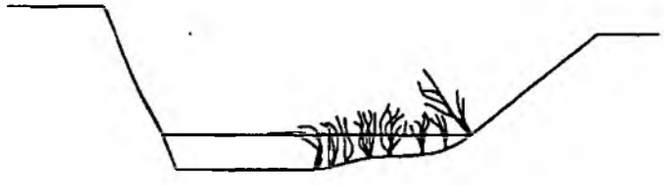
- Bend to RHB ... then straight
- Ponded by bridge foundation but 0·3 + ms^{-1}
- Depth 0·5 - 1 m ... shallowest on crest of bend
  ... location indicated on map (not really riffle)
- 8 m narrowing soon to 6 m
- Gravel / sand

- No submerged macrophytes
- Margins mainly overgrown *Urtica / Solanum / Epilobium*
- Isolated *Phalaris / G. maxima* on point of bend RHB
- LHB *Salix / Fraxinus / Crataegus* 15 % ... RHB *Crataegus* 30 %

- Access OK both banks ... some parts not to water

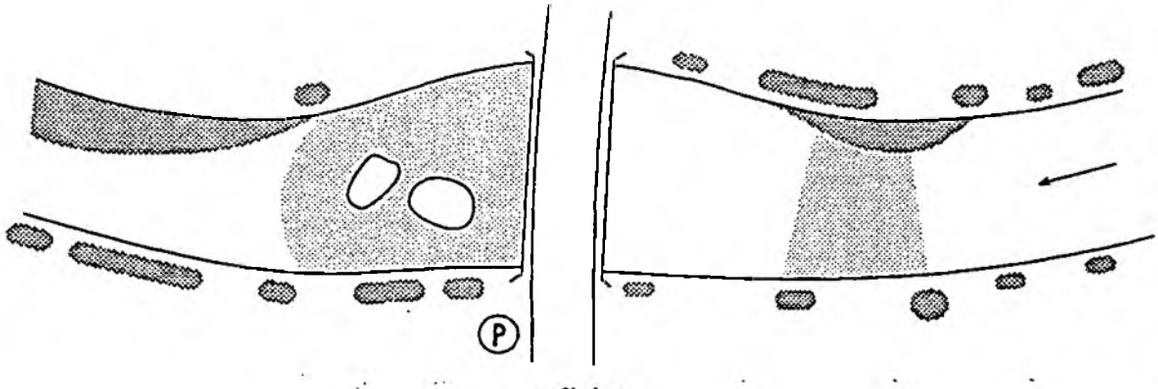
Downstream

- Straight 10 m ... then after 20 m gentle bend to RHB 5 m
- Sill 0·3 m grading into riffle (mostly artificial material) ... no more in 200 m
- Small shoals in the wide section
- 1 ms^{-1} riffle ... then 0·3 ms^{-1}
- Gravel / sand



- No submerged macrophytes
- *Apium / V. beccabunga* on shoals
- 70 % *Phalaris* ... including 1 - 2 m on inside of bend
- RHB bare ... LHB 40 % *Crataegus / Sambucus*

- Access OK RHB ... LHB rarely to water



2 Reach surveys

2.1 Orston u/s

Survey of the Smite from Orston road bridge (§ 1.10) up to Whatton (§ 1.9), from LHB. Access excellent LHB, varied (but unnecessary) RHB. Survey starts at the downstream end and passes upstream, measuring by paces. All LHB boundaries (fences *etc*) and some RHB boundaries recorded for comparison with Ordnance Survey maps.

0		Road bridge (SK 765 412)
0 - 260		Run / pool ... 0·5 m gravel / sand at d/s end
		... sand / gravel by 100 ... deepening to 1 m at u/s end
	RHB	100 % *Crataegus* / *Fraxinus* / *Acer* / *Quercus* / *Rubus*
	LHB	90 % *Crataegus* / *Fraxinus* / *Acer* / *Rubus*
30	MID	Some *P. perfoliatus*
35	LHB	*V. beccabunga*
88	LHB	Tiny *Callitriche*
	MID	Some *Cladophora*
96	LHB	Embayment (disused cattle drink ?)
260	MID	Extensive *P. perfoliatus*
	LHB	Fence
260 - 350		Shallowing again to 0·5 m
350	MID	Much *P. pectinatus* (run)
		Much *P. perfoliatus* (run)
410	RHB	*Apium* (quite dry)
		Plenty of *S. erectum*
	LHB	Fence
260 - 410	LHB	80 % *Crataegus*
	RHB	5 % *Crataegus*
440	LHB	Embayment (disused cattle drink ?)
		... *V. beccabunga* either side of embayment
	MID	... *P. perfoliatus* (run)
450	RHB	*S. erectum*
500	LHB	Fence
	MID	Patches of *P. pectinatus* (run)
410 - 500	LHB	80 % *Crataegus*
	RHB	10 % *Crataegus*
550 - 610	RHB	Several patches of *V. beccabunga*
610	LHB	Large patch *V. beccabunga*
630	LHB	*Phalaris*
550 - 660		Shallow, slow, sand / gravel
	LHB	80 % *Crataegus*
	RHB	50 % *Crataegus*
666	RHB	*Phalaris*
670	RHB	*V. beccabunga*
662 - 684	LHB	*S. erectum*

684 - 690	LHB	Large stand of *V. beccabunga*
688 & 694	RHB	*Phalaris*
700 - 710	LHB	Large stand of *V. beccabunga*
714	LHB	Good *Apium*
716 & 730	RHB	Small patches of *Callitriche*
716 - 742	LHB	Various *V. beccabunga* and *Apium*
788	RHB	*Apium*
800 - 810		Weak gravel riffle
808 & 816	LHB	*V. beccabunga* [last systematic record]
834	LHB	Old fence
660 - 834	LHB	No trees
	RHB	Isolated (< 1 %) *Crataegus*
860	RHB	*S. erectum*
874	RHB	*Apium*
912	RHB	*Phalaris*
932	BOTH	*Apium*
980 - 1000	LHB	*S. erectum*
1000 - 1026	LHB	Gravel shoal
984 - 1020		Fast run ... stone / gravel
1060 - 1080	RHB	*Apium* [last systematic record]
1090	LHB	Fence
834 - 1090	LHB	15 % *Crataegus*
	RHB	10 % *Crataegus*
1088 - 1094		Gravel riffle
1110	RHB	Silt ... leaf litter
1120 - 1136	BOTH	*G. maxima*
1130 - 1136		Riffle
1146	LHB	Good *Callitriche*
1154	LHB	*Scrophularia* (yes, below NWL)
1200	RHB	*Phalaris*
1238	RHB	Silt ... no leaf litter ?
1260	LHB	Fence
1280	RHB	Fence
1280 - 1292		Gravel riffle
1340 - 1354		Gravel riffle
1360	LHB	*Phalaris*
1394 - 1402		Gravel riffle
		... NB section u/s from 1280 good for riffle spacing at NWL
		... no further riffles recorded at present (dusk approaching)
1090 - 1400	LHB	80 % *Crataegus*
	RHB	70 % *Crataegus / Fraxinus / Acer*
1402	RHB	*Phalaris*
1414 & 1418	LHB	*Phalaris*
1458	RHB	*Phalaris*
1470 - 1600		Not surveyed ... access difficult
1600	LHB	Fence
1598 - 1610		Gravel riffle

1728	RHB	Cattle drink
1730	LHB	*S. erectum*
1740	RHB	*Phalaris*
1768 & 1774	LHB	*Phalaris*
1780	BOTH	*Phalaris* [last systematic record]
1786	LHB	*S. erectum* [last systematic record]
1840	LHB	Cattle drink
1874	MID	*P. pectinatus* (run)
1904 - 1910		Gravel riffle [last systematic record]
1960	LHB	Fence
1400 - 1960	LHB	5 % *Crataegus*
	RHB	2 % *Crataegus*
1980 - 1994		Gravel riffle
1988	MID	*P. pectinatus* (riffle)
2060	LHB	Cattle drink
	RHB	*Callitriche*
2070 - 2150	LHB	Excellent *Phalaris*
2150	LHB	Fence
	MID	Weir
2192 - 2208		Stone riffle
2200 - 2214		Railway bridge
2200 - 2230	MID	*P. pectinatus* (run & riffle)
1960 - 2200	LHB	5 % *Crataegus* / *Salix*
	RHB	5 % *Crataegus*
2260	RHB	*Callitriche*
2262	RHB	*Agrostis*
2264	RHB	Entry of drainage channel
2300 +		Red sandstone? briefly dominant
2362 - 2532		Strong riffle / pool series
		... excellent *P. pectinatus* run & riffle [last systematic record]
2400 - 2424	RHB	Beds of *Agrostis*
2480	RHB	Fence
2532	LHB	Fence
2200 - 2532	LHB	50 % *Crataegus*
	RHB	15 % *Crataegus*
2620	LHB	Cattle drink
2710	LHB	Fence & ditch
2776 - 2788		Stone riffle
2794	LHB	Fence
2794		Farm bridge
2532 - 2794	LHB	20 % Crataegus
	RHB	Various trees ... domestic land
2838	LHB	Cattle drink
2950	LHB	Fence
2968	RHB	Cattle drink
2982		Farm bridge

2794 - 2982	LHB	10 % *Crataegus*
	RHB	50 % *Crataegus* / *Fraxinus*
3000	LHB	Cattle drink
2982 - 3100	LHB	70 % *Crataegus*
	RHB	70 % *Crataegus* / *Fraxinus*
3100		Road bridge (SK 742 395)

2.2 Oscar Bridge d/s

Survey of the Smite from Oscar Bridge (§ 1.11) down to Shelton (§ 1.12), from LHB. Access excellent LHB and RHB, probably best LHB. Survey starts at the upstream end and passes downstream, measuring by paces. No records of riparian trees.

0		Road bridge (SK 773 427)
0 - 16		Gravel riffle
6	MID	*Apium* on shoal
8	RHB	*Apium*
14	LHB	*Phalaris*
16 - 312		Shallow gravel run
22	RHB	*Apium*
26	RHB	*Phalaris*
32 - 36	RHB	*V. beccabunga*
44 - 54	LHB	*Phalaris*
52	RHB	*V. beccabunga*
54	RHB	*Apium*
56	RHB	*V. beccabunga*
62	LHB	*Phalaris*
64	RHB	*Phalaris*
66 - 84	LHB	*Phalaris*
70	RHB	*V. beccabunga*
92 - 98	LHB	*Phalaris*
102 - 110	LHB	*Phalaris* [last systematic record]
114 - 116	LHB	*V. beccabunga*
204	RHB	*Scrophularia*
226 - 228	RHB	*V. beccabunga*
226 - 230	LHB	*V. beccabunga* [last systematic record]
268	LHB	*Scrophularia*
284 & 286	LHB	*R. nasturtium-aquaticum*
312 - 328		Weak gravel riffle
328 - 356		Shallow gravel run
356 - 368		Weak gravel riffle
364	LHB	Fence
368 - 390		Shallow gravel run
390	RHB	*Apium*
390 - 400		Weak gravel riffle
400 - 550		Shallow gravel run

400	RHB	Fence
434	LHB	*V. beccabunga* ... 3 good stands
452	RHB	*Apium*
456	RHB	*Apium*
474	RHB	*Apium* [last systematic record]
550 - 558		Stone / gravel riffle ... excellent *Apium* and *V. beccabunga*
558 - 1114		Run
566 & 568	LHB	Two large stands *R. nasturtium-aquaticum*
572	BOTH	*Typha* (weak)
604	RHB	*R. nasturtium-aquaticum*
616	RHB	*Scrophularia*
620	RHB	Good *Apium* / *R. nasturtium-aquaticum*
630	?	Note of good *Phalaris*
758	?	Note of good *V. beccabunga*
816 - 826	LHB	*G. maxima*
	RHB	Patches of *G. maxima*
922 - 934	LHB	*G. maxima*
936	LHB	Fence
982	LHB	*Scrophularia*
1102	LHB	Start of wood ... end of wood not recorded
1114 - 1126		Gravel riffle
1126 - 1242		Run
1242 - 1318		Mixed riffle / run
1318 - 1374		Run
1340 - 1346	LHB	*G. maxima*
1360	LHB	*R. nasturtium-aquaticum* (lots of *Apium* along here)
1374 - 1384		Stone / gravel riffle
1384 - 1840		Run
1600	LHB	Fence
1682 - 1690	RHB	*S. erectum*
1704 - 1710	RHB	*S. erectum*
1840		Farm bridge (SK 778 442)

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D IDENTIFICATION NOTES – CHIRONOMIDAE: TANYPODINAE

Fittkau and Roback (1983) listed the Tanypodinae genera of the Holarctic region, with their diagnoses and notes on their identification, ecology and distribution. A summary of the information on ecology and distribution is given below, with asterisks marking those genera which might be expected in Palaearctic (*eg* British Isles) running waters.

Ablabesmyia * ... eurytopic ... at present 4 species are known from the Palaearctic
Alotanypus ... two nearctic and 1 Australian species are known
Anatopynia ... shallow ponds and lakes ... one species is known from the Palaearctic
Apsectrotanypus * ... small, cool flowing bodies of water ... one species *A. trifascipennis* is known from the western Palaearctic
Arctopelopia ... oligotrophic standing water bodies ... 3 species are known from the Palaearctic
Brundiniella ... known only from the Nearctic
Cantopelopia ... comes from the Nearctic and Africa
Clinotanypus * ... soft sediments of shallow, warm water bodies ... ponds, lakes and slowly-flowing streams and rivers ... one species *C. nervosus* lives in the western Palaearctic
Coelotanypus ... not known from the Palaearctic
Conchapelopia * ... polyoxybiontic, more or less cold-stenothermic inhabitants of flowing waters and lakes (a few species eurythermic) ... 7 species Palaearctic
Derotanypus ... small, cold standing and flowing water ... range seems to be restricted to northern and montane regions [example sites suggest very northern and very montane]
Djalmabatista ... not in western Palaearctic
Fittkauimyia ... has not yet been found in the Palaearctic
Guttipelopia ... primarily in shallow bodies of standing water ... one species Holarctic
Helopelopia ... both species occur in the Nearctic
Hudsonimyia ... the two known species ... live in North America
Krenopelopia ... 3 species from the Palaearctic ... colonise the littoral of cold lakes
Labrundinia ... the only European species prefers bogs
Larsia * ... great variety of habitats ... 2 species from the western Palaearctic
Macropelopia * ... fine sediments in cool water bodies (springs, brooks, lakes and bogs) ... about 10 species from Palaearctic
Meropelopia ... two Nearctic species are known
Monopelopia ... small and very small bodies of water ... acid boggy biotopes preferred ... one species from Palaearctic
Natarsia * ... 2 European species ... inhabitat cool streams, springs and the littoral zone of montane or northern lakes
Nilotanypus * ... 2 types from western Palaearctic ... rapidly flowing waters, where they colonize lentic habitats
Paramerina ... variety of substrata in small or stagnant still waters ... 4 Palaearctic species
Parapelopia ... only from Nearctic
Pentaneura ... running water ... only from Nearctic
Pentaneurella ... one species ... springs and streams in Finland and Norway
Procladius * ... muddy substrata of standing or slowly flowing water bodies ... more than 60 species described from Europe, but very many synonymous
Psectrotanypus * ... sediments of small, nutrient-rich, standing or slow-flowing water bodies ... 1 species from western Palaearctic

Rheopelopia * ... rheobiontic ... young stages live among *aufwuchs* ... 4 species from Palaearctic
Tanypus * ... 4 Palaearctic species ... soft sediments of shallow standing and flowing water ... temperate or warm climate
Telmatopelopia ... One Palaearctic species *T. nemorum* ... acid woodland pools and bog margins
Telopelopia ... running waters ... nearest is Mediterranean
Thienemannimyia * ... Polyoxybiontic, largely cold-stenothermic, preferring sandy-muddy stream substrata ... 11 species from Palaearctic
Trissopelopia * ... cold-stenothermic ... running waters, springs and littoral of lakes ... 2 species from Palaearctic
Xenopelopia * ... variety of small water bodies and littoral of lakes ... 2 species from Europe
Zavrelimyia * ... sandy or detritus-rich sediments of springs, or of lentic habitats of stream sections close by ... 6 species Holarctic

The key provided by Fittkau and Roback (1983) therefore includes many genera which are not expected from Palaearctic running waters. An abbreviated version of their key was compiled, also with the relevant illustrations brought together for ready comparison. The shortened key is shown below, with the re-organised figures on following pages.

1 Body segments relatively broad, with fringe of swim-setae. Head rounded to oval, cephalic index 0·65-1·00. Dorsomentum with row of teeth, with or without dorso- mental plates. Anal tubules at most twice as long as wide ... 2
– Body segments relatively slender, without fringe of swim- setae. Head longish-oval to narrow, cephalic index 0·40-0·67. Without row of teeth in area of mentum. Anal tubules at least thrice as long as wide ... 8

2 Cephalic index 0·65-0·70, head gradually tapered anteriorly. Dorsomental teeth not located on distinct plate. Anal tubules situated at tip of abdomen. Small pointed papilla between procerci ... *Clinotanypus*
– Cephalic index 0·75-1·00, head rounded anteriorly. Dorsomental teeth located on distinctly-defined plate. Anal tubules situated at base of posterior parapods. No pointed papilla ... 3

3 Cephalic index about 1·00. Mandible expanded in basal half, apical tooth short, about 1/5 length of mandible. No pseudoradula. Pecten hypopharyngis strongly reduced, scarcely noticeable ... *Tanypus*
– Cephalic index less than 0·95. Mandible more or less smoothly curved from base to apex, apical tooth at least 1/4 length of mandible. M appendage with pseudoradula. Pecten hypopharyngis not reduced, distinctly visible ... 4

4 Mandible with relatively large, blunt basal tooth. Apical 1/2 of ligula black ... *Procladius* 5
– Mandible with or without more or less large, pointed basal tooth. Teeth of ligula pale or dark to dark brown ... 6

5 Main point of paraligula at most twice as long as accessory points. Accessory points of equal size, twice as numerous on outer side as inner side. Pecten hypopharyngis with less than ten short teeth in sparse row ... *P. (Psilotanypus)*

– Main point of paraligula at least three times as long as accessory points. Accessory points exceptionally large, none or a few on inner side. Pecten hypopharyngis with close row of more than 10 normal teeth, and some short teeth close to this row ... *P. (Holotanypus)*

6 Ligula with 4 teeth. Mandible with large, prominent, simple basal tooth ... *Psectrotanypus*

– Ligula with 5 teeth. Basal tooth of mandible absent or bifid ... 7

7 Dorsomentum with 4 large and 1 very small tooth; outermost tooth may be absent. Ring organ of maxillary palp located in middle of basal segment or a little proximal. Antennal segment 2 very short, 2·5 times as long as wide. Style and Lauterborn organs set well back from apical margin of antennal segment 2 ... *Apsectrotanypus*

– Dorsomentum with 6-8 large inner teth andvery small outer tooth. Ring organ of maxillary palp located in distal part of proximal 1/3 of basal segment. Antennal segment 2 moderately long, 3·5 times as long as wide; style and Lauterborn organs situated on apical margin of antennal segment 2 ... *Macropelopia*

8 Basal segment of maxillary palp subdivided into 2-5 segments ... *Ablabesmyia*

– Basal segment of maxillary palp not divided ... 9

9 Inner tooth of ligula smaller and shorter than middle tooth, which is at least as large as outer tooth. Area of muscle attachment on ligula more or less triangular, occupying basal quarter ... *Nilotanypus*

– Inner tooth of ligula larger or more or less equal in length to middle tooth. Area of muscle attachment otherwise ... 10

10 Lauterborn organs large, as long as antennal segment 3, strongly chitinized and fused with end of segment 2 to give a tuning-fork appearance. Last antennal segment about equal in length to third ... *Xenopelopia*

– Lauterborn organs small, at most 1/2 as long as segment 3, weakly chitinised and not fused with segment 2. Last antennal segment usually shorter than third ... 11

11 Mandible with large basal tooth. Point of inner tooth of ligula straight or curved outwards, middle tooth usually not deeply recessed, inner tooth not or only weakly fused with outer tooth ... 12

– Mandible without large basal tooth. Point of inner tooth of ligula always curved outwards, middle tooth always strongly recessed, inner tooth always fused to some extent with outer tooth ... 14

12 Point of inner tooth of ligula straight; area of muscle attachment a narrow, basal stripe ... 13
– Point of inner tooth of ligula more or less curved outwards; area of muscle attachment otherwise ... *Zavrelimyia*

13 Mandible with very large, shovel-like basal tooth and smaller accessory tooth. Ring organ of palp situated in apical 1/3 of basal segment. Antenna twice as long as mandible ... *Natarsia*
– Mandible with large, low basal tooth and large accessory tooth. Ring organ of palp in middle 1/3 of basal segment. Antenna at least thrice length of mandible ... *Larsia*

14 Ring organ of palp situated in middle 1/3 of basal segment, slightly proximal or distal to middle of segment. Pecten hypopharyngis with large corner tooth and long teeth in middle of row. Psudoradula linked with sclerotized zone basally ... *Trissopelopia*
– Ring organ of palp situated in distal 1/3 of basal segment. Pecten hypopharyngis without a particularly strong corner tooth or particularly long teeth in middle of row. Pseudoradula not linked to sclerotized zone basally ... 15

15 Maxillary palp with b seta 2-segmented ... *Thienemannimyia*
– Maxillary palp with b seta 3-segmented ... 16

16 Basal tooth and accessory tooth of mandible not clearly discernible. Pseudoradula broad basally, strongly tapered to apex. Subbasal seta of posterior parapod may be unevenly bifid ... *Rheopelopia*
– Basal tooth and accessory tooth of mandible insignificant but clearly distinguishable. Pseudoradula only weakly tapered from base to apex. Subbasal seta simple ... *Conchapelopia*

Five genera – *Ablabesmyia, Macropelopia, Procladius (Holotanypus), Psectrocladius and Thienemannimyia* – were found in the previous studies of rivers in Anglian Region. More genera are expected in the 1992 samples, taken from a wider environmental range.

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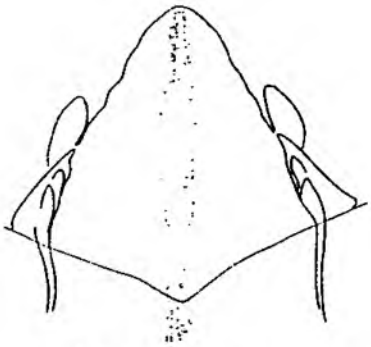
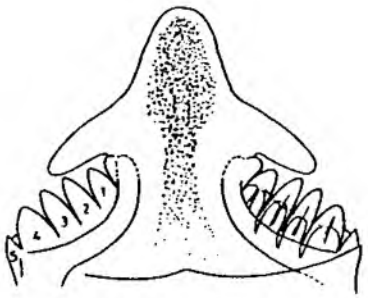
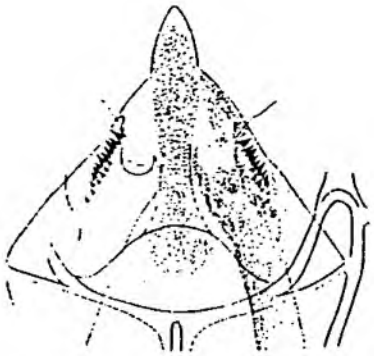


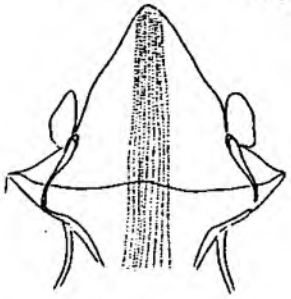
ABLABESMYIA



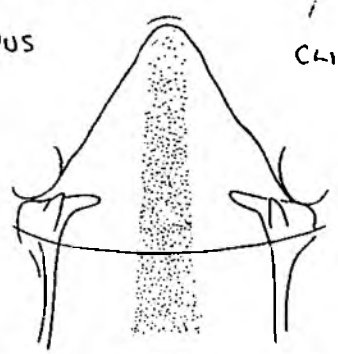
APSECTROTANYPUS



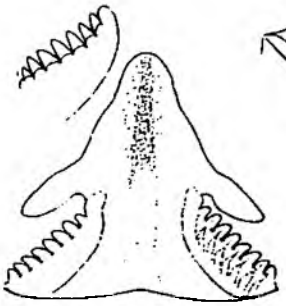
CLINOTANYPUS



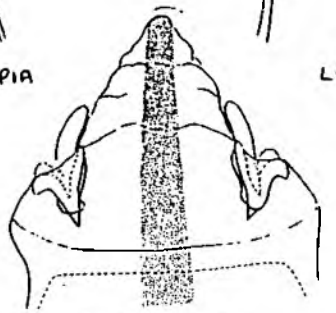
CONCHAPELOPIA



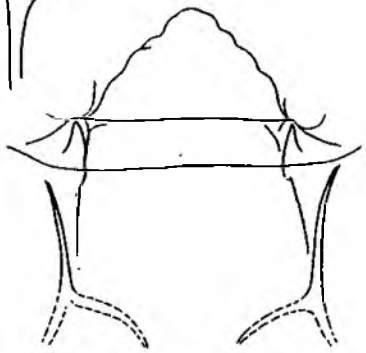
LARSIA



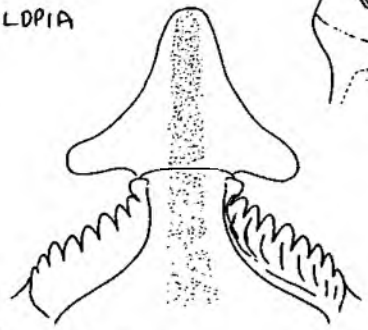
MACROPELOPIA



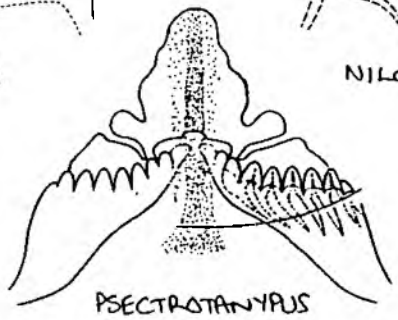
NATARSIA



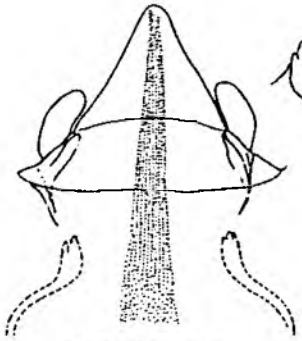
NILOTANYPUS



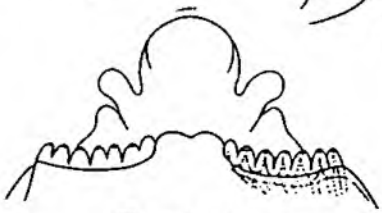
PROCLADIUS



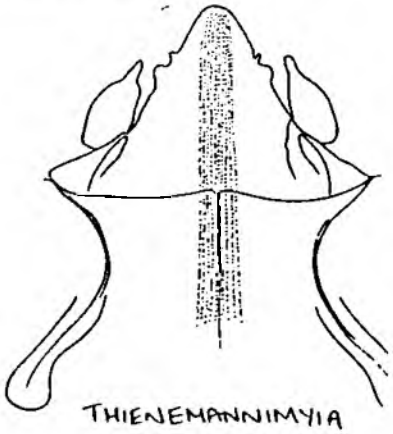
PSECTROTANYPUS



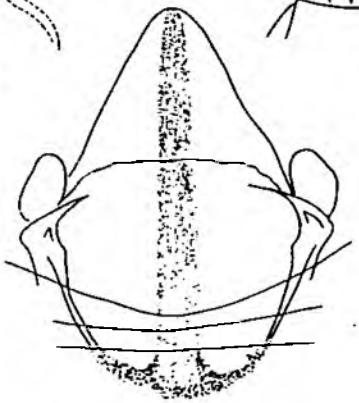
RHEOPELOPIA



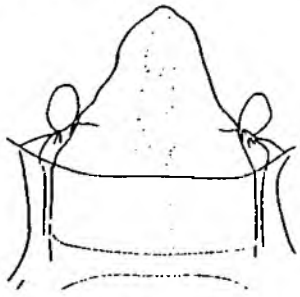
TANYPUS



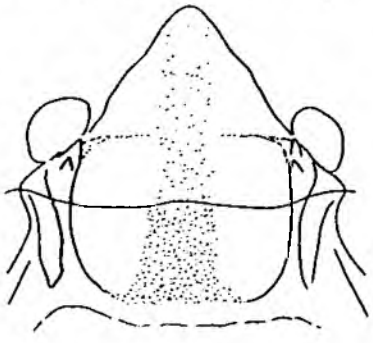
THIENEMANNIMYIA



TRISSOPELOPIA



XENOPELOPIA



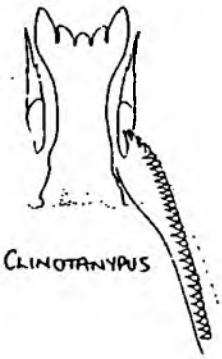
ZAVRELIMYIA

TANYPODINAE

- MENTUM & M APPENDAGE

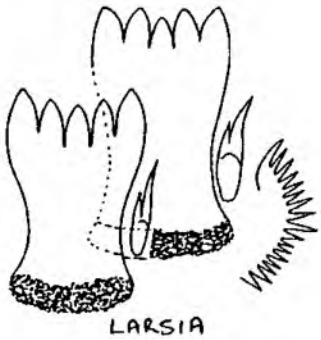
ABLABESMYIA

APSECTROTANYPUS

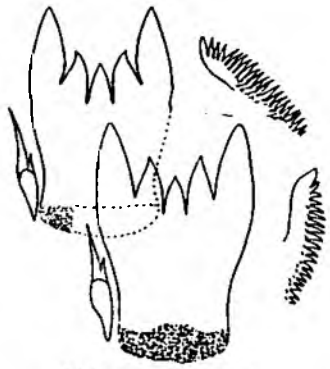


CLINOTANYPUS

CONCHAPELOPIA



LARSIA



MACROPELOPIA

NATARSIA

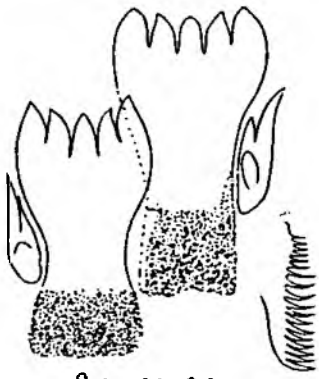
NILOTANYPUS

(HOLOTANYPUS)

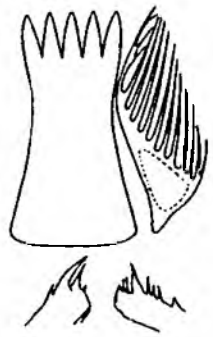
PROCLADIUS

(PSILOTANYPUS)

PSECTROTANYPUS



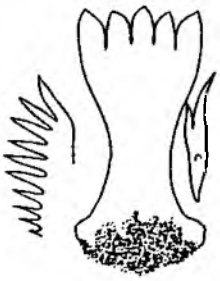
RHEOPELOPIA



TANYPUS

THIENEMANNIMYIA

TRISSOPELOPIA

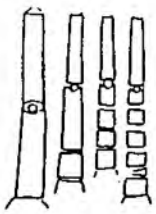


XENOPELOPIA

ZAVRELIMYIA

TANYPODINAE

- LIGULA, PARALIGULA & PECTEN HYPOPHARYNGIS

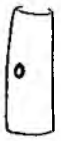


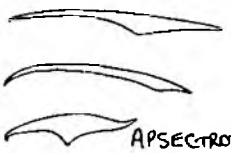
ABLABESMYIA

PROCLADIUS

(HOLO...)

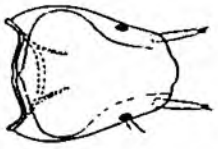
(PSILO...)

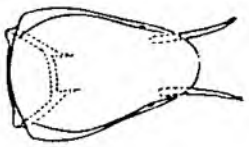




APSECTROTANYPUS

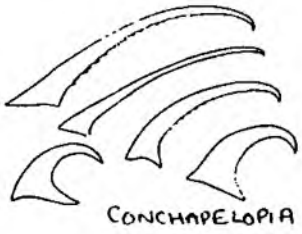
PSECTROTANYPUS



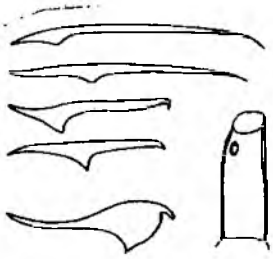


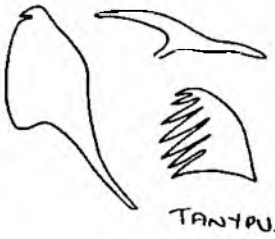
CLINOTANYPUS

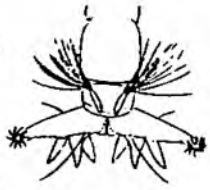
RHEOPELOPIA



CONCHAPELOPIA

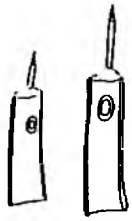




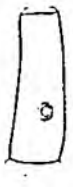


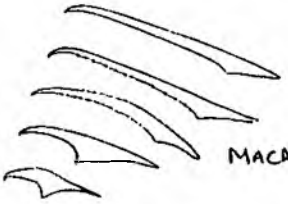
TANYPUS

LARSIA



THIENEMANNIMYIA



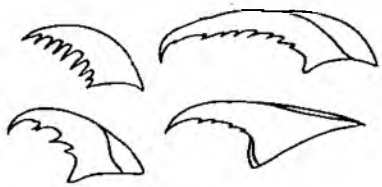


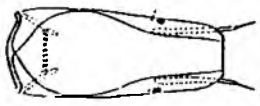
MACROPELOPIA

TRISSOPELOPIA

NATARSIA

XENOPELOPIA





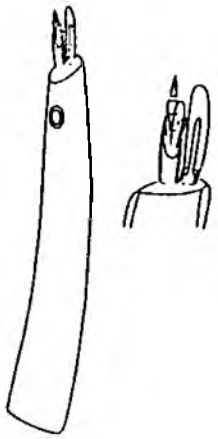
NILOTANYPUS

ZAVRELIMYIA

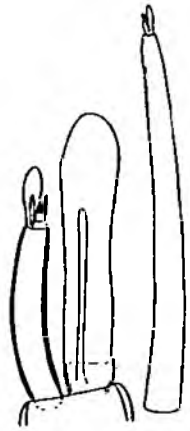
TANYPODINAE

- MAXILLARY PALP, CLAWS OF POSTERIOR PARAPOD *et al.*

ABLABESMYIA

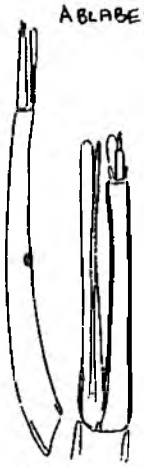


APSECTROTANYPUS

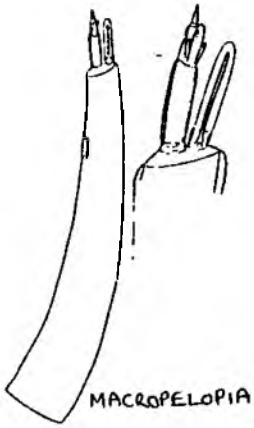


CLINOTANYPUS

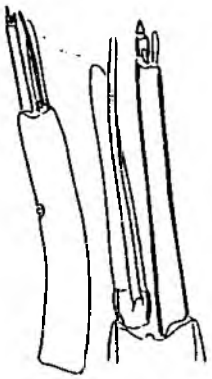
CONCHAPELOPIA



LARSIA

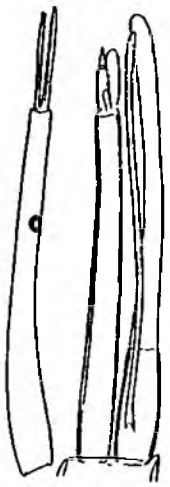


MACROPELOPIA

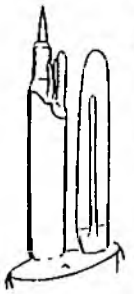


NATARSIA

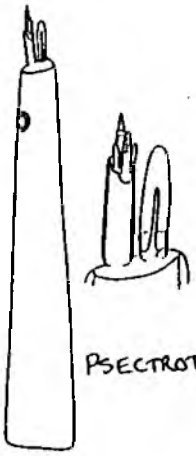
NILOTANYPUS



RHEOPELOPIA

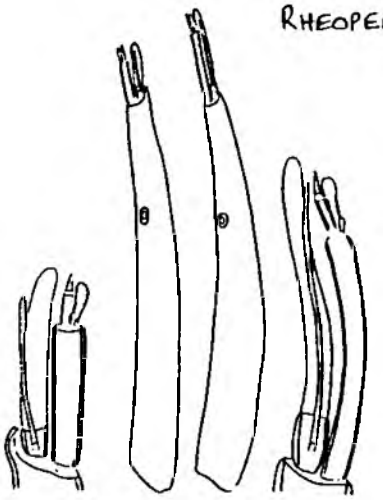


PROCLADIUS



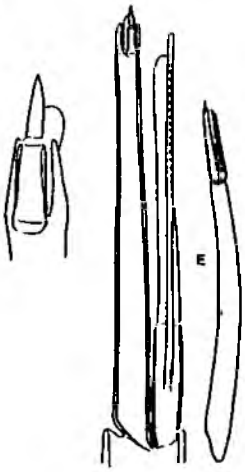
PSECTROTANYPUS

TANYPUS



THIENEMANNIMYIA

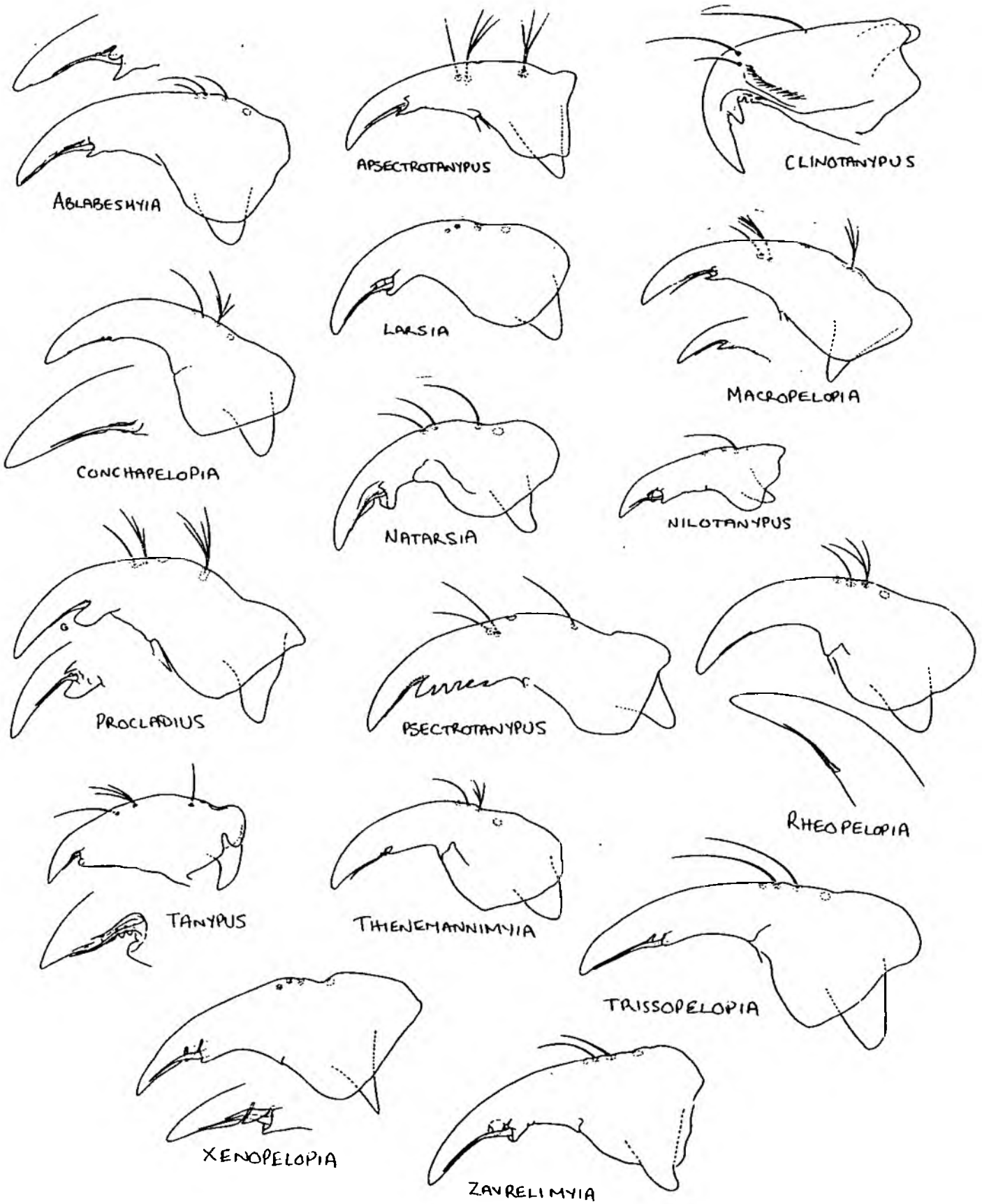
TRISSOPELOPIA



XENOPELOPIA

ZAVRELIMYIA

TANYPODINAE
– ANTENNA



TANYPODINAE

- MANDIBLE

NOTES