Evaluation of a revised version of Canal PSYM based on edge only invertebrate samples

Report to the Environment Agency (Midlands Region)

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The Ponds Conservation Trust: Policy & Research

EXECUTIVE SUMMARY

This report describes the results of an evaluation of a revised version of Canal PSYM based on invertebrate data collected from edge habitats only.

The evaluation showed that:

(i) there was little difference in the TWINSPAN classification of sites using the edge sample data set. In the revised analysis five TWINSPAN end-groups were identified with broadly similar composition to the end-groups originally identified.

(ii) prediction of baseline invertebrate assemblages could be achieved with five environmental variables, as opposed to six in the original analysis. Four of the environmental variables used were unchanged, with alkalinity replaced by turbidity (Secchi depth) in the revised analysis.

(iii) the most effective metrics for measuring environmental degradation remained unchanged and were:

- Average Score per Taxon (ASPT)
- Number of Ephemeroptera, Plecoptera and Trichoptera families (EPT)
- Total number of invertebrate families (NFAM)
- Number of beetle families (FCOL).

(iv) there was no change in the ability of the revised version of PSYM to distinguish high quality from degraded sites.

(v) there was little difference in the results of comparisons of replicate canal samples from locations with reinforced and natural banks. As in the original analysis ASPT and EPT could be used to assess water quality in canals regardless of bank type, although ASPT results remained rather variable at sites where very few taxa were recorded.

In the revised version of PSYM number of beetle families and total number of invertebrate families were good predictors of bank habitat quality regardless of water quality.

Overall, it is concluded that the revised version of Canal PSYM using only edge samples functioned as effectively as the original version.

1. Introduction

As part of the Environment Agency R&D Project E1-062 "Biological techniques of still water quality assessment" a new biological method for assessing the ecological quality of canals was developed using the predictive multimetric approach known as PSYM (Williams *et al*. 2000).

Canal PSYM[1] was developed using invertebrate data based on samples collected from both the canal margins and deeper water. Specifically the sampling method comprised: (i) two minutes of semi-continuous sampling of the canal margin, shallows and any emergent plants present using a standard pond net (ii) four net hauls from deeper bottom sediments, either collected by an operator wading in the water and using a long-handled pond net, or by throwing a Medium Naturalist's dredge from the canal bank and (iii) a one-minute search for surface dwelling or other species commonly overlooked in hand-net sampling. The margin and deep water samples were processed separately, and then combined at the data analysis stage to give a combied edge/deep water invertebrate species list which was used in the development of the Canal PSYM method.

Following the initial development of Canal PSYM further assessment of the health and safety implications of sampling canals was undertaken by the Environment Agency. This indicated that, as far as possible, deep-water sampling and the use of dredges, should be avoided.

In the light of canal sampling health and safety recommendations it was decided to undertake an evaluation of the effectiveness of Canal PSYM constructed using only edge invertebrate samples.

2. Methodology used for the evaluation

2.1 Introduction

In order to evaluate the effectiveness of the PSYM model based on edge samples alone the PSYM prediction software was re-developed using only edge samples.

This was a four-stage process involving:

(i) reclassification with TWINSPAN of minimally impaired sites using species lists based only on the edge and one minute search components of the sample

(ii) redevelopment of the Multiple Discriminant Analysis equations used to predict the expected fauna of canals using the revised TWINSPAN classifcation

(iii) re-testing of all potential metrics to assess their suitability for describing environmental degradation in canals.

(iv) a repeat of the initial tests of the use of PSYM using the revised version of the model.

Differences between the output derived from the original PSYM model and the revised model were assessed.

2.2 Survey sites and samples

[1]PSYM: the Predictive SYstem for Multimetrics

2.2.1 Data sets

The reanalysis of the canal data used the same set of sites as the original PSYM analysis. This dataset comprised information on macroinvertebrate species composition and relative abundance, vegetation cover and physico-chemical data collected from 94 canal sites (70 sites in 1997, 24 in 1999). At 19 of the canal sites two sets of invertebrate samples and environmental data were collected, one from from natural banks and one from reinforced bank sections. In total, therefore, 113 samples were collected: 83 in 1997 and 30 in 1999.

2.2.2 Selection of reference and degrqaded sites

Minimally impaired canal sites were drawn from the following canals, as in the initial analysis: Ashby, Basingstoke, Bridgewater and Taunton, Cannock Extension, Grand Union, Grantham, Huddersfield Narrow, Kennet and Avon, Lancaster, Leeds-Liverpool, Llangollen, Leven, Monmouthshire and Brecon, Montgomery, Newport, Oxford, Pocklington, Ripon, Shropshire Union and Stourbridge.

During initial exploratory analysis of the edge sample dataset DECORANA analysis indicated that two of the original 47 sites used in the development of the baseline classification (Sites 63 and 70 on the Llangollen and Shropshire Canals, respectively) were outliers which distorted the analysis. These sites were removed and the classification was subsequently develop with 45 minimally impaired sites.

The combined minimally impaired and degraded site database used for metric development remained unchanged for the reanlaysis of the database. A list of the canals surveyed is given in Appendix 1.

2.3 Biological data used in the evaluation of PSYM

The re-analysis of the PSYM database used only the edge and one-minute search sample data. Taxa included in the analysis are listed in Table 2.1. Appendix 2 gives a full list of taxa used in the analysis for each site.

Table 2.1 Macroinvertebrate taxa used in the re-analysis of canal data

Taxon	*Identification level*	*Taxon*	*Identification level*
Tricladida	Species	Hemiptera	Species
Gastropoda	Species	Coleoptera	Species
Bivalvia[1]	Species	Plecoptera	Species
Crustacea (Malacostraca)	Species	Lepidoptera	Species
Hirudinea	Species	Trichoptera	Species
Ephemeroptera	Species	Oligochaeta	Class[2]
Odonata	Species	Diptera	Family[2]
Megaloptera (inc. spongeflies)	Species		

[1] Including *Sphaerium* spp., but excluding *Pisidium* spp. (which were retained for identification, if necessary, at a later stage).
[2] Groups retained for identification, if necessary, at later stage.

2.4 Physical and chemical data used in the re-analysis of Canal PSYM

All environmental data used in the re-analysis of the PSYM database were the same as in the orignal analysis. Table 2.2 list the environmental variables used. Appendix 3 provides a complete list of all environmental data.

Table 2.2 Physico-chemical data gathered from water bodies

Location	Water chemistry:
Altitude	pH
Water depth	Conductivity
Lithology	Suspendedsolids
Drawdown	Totalalkalinity
Catchment size	Totalphosphorus
Pond area	Solublereactivephosphorus
Shade	Totalnitrogen
Fish	Totaloxidisednitrogen
Mesohabitats	Chloride
Sediment depth and type	Calcium
Permanence	Magnesium
Water source and inflows	Sodium
Margin complexity	Potassium
Age	Iron
Grazing and trampling	Zinc
Vegetation cover	Copper
Surrounding land use	Nickel
Adjacent wetlands	Aluminium

2.5 Selection of metrics

The approach to metric development was the same as in the original analysis with the same set of potential metrics tested as in the original PSYM analysis.

As in the original analysis, only metrics which were correlated with environmental degradation factors at probability levels of $P \leq 0.001$ were considered in subsequent analyses.

A complete list of the potential metrics that were evaluated is given in Appendix 4.

3. Results

3.1 The revised dataset

Removing those species present only in bottom samples made a very slight difference to the species lists for each site. Appendix 5 summarises the species which were removed from each site as a result of omitting bottom samples.

3.2 Canal TWINSPAN classification

The revised TWINSPAN classification of canal sites using edge samples broadly resembled the original combined samples classification (see Figures 3.1 and 3.2).

The revised TWINSPAN had five end-groups rather than the original seven. Essentially this was due to Groups 1 and 2 and Groups 5 and 6 of the original classification combining into single groups. The original Group 7 (now Group 5) was reduced to only three sites following the removal of the outlying Sites 63 and 70.

The slight changes seen in the groupings of sites following reanalysis were quite typical of the response of TWINSPAN to small changes in taxonomic lists. Overall, these differences made little alteration to the revised version of PSYM.

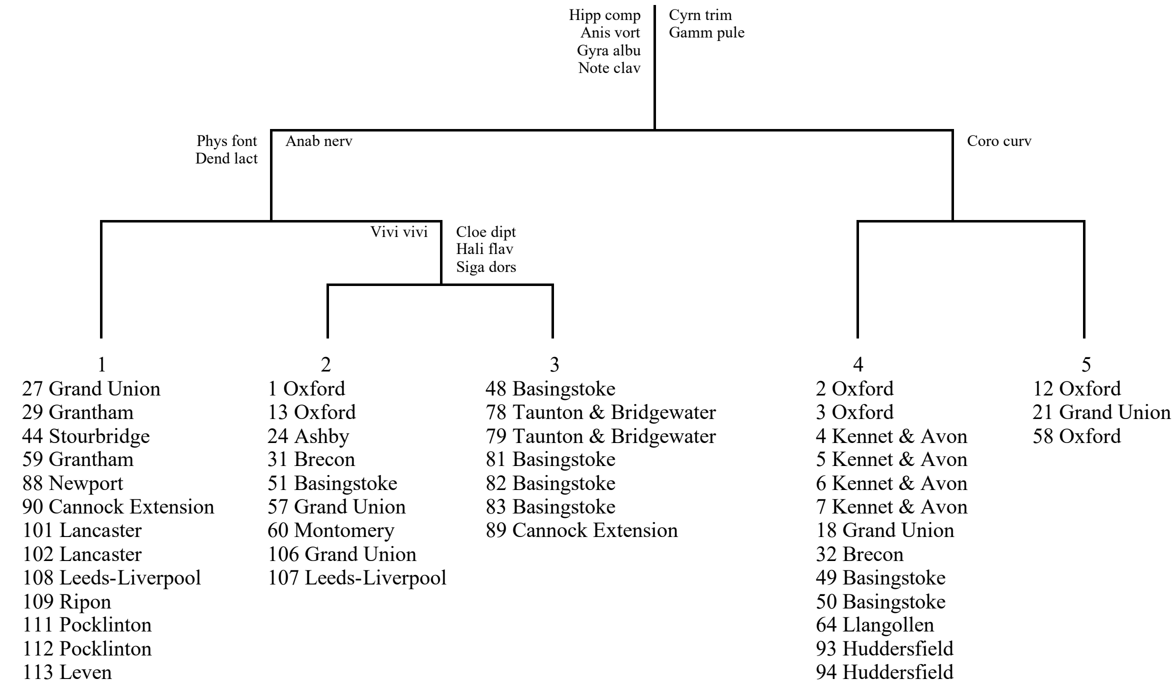

Figure 2.1. Revised TWINSPAN classification of canal invertebrate assemblages using edge samples only

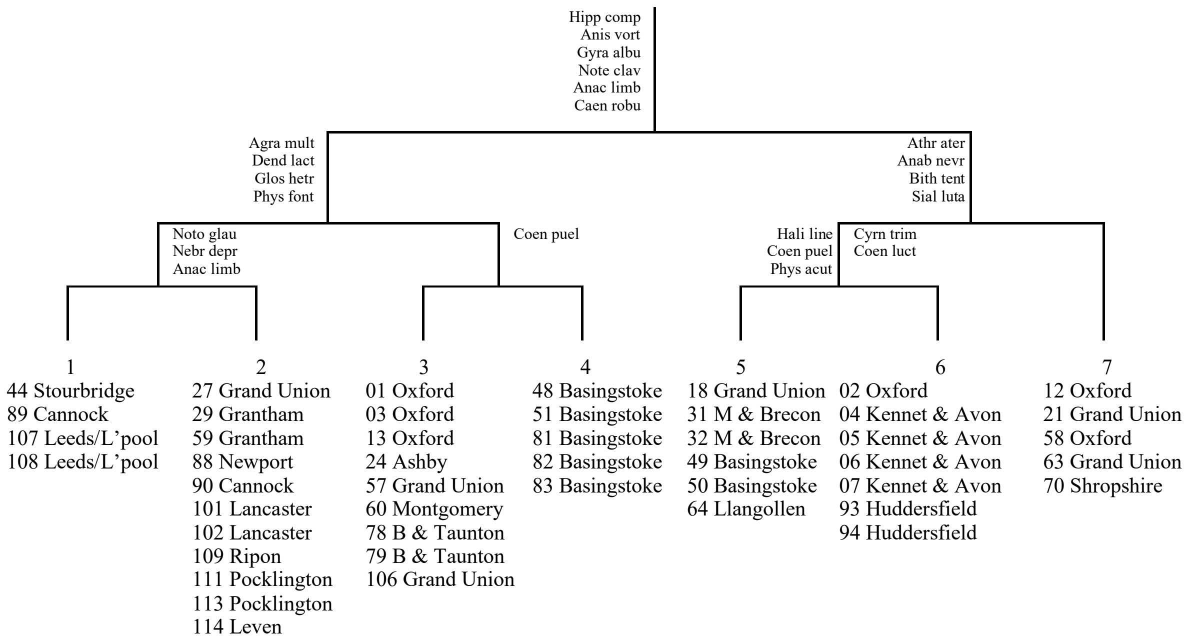

Figure 2.2. Original TWINSPAN classification of canal invertebrate assemblages using combined edge and bottom samples

3.3 MDA prediction of TWINSPAN end-groups from environmental variables alone

Multiple Discriminant Analysis was used to identify environmental variables which could predict site membership of TWINSPAN end-groups. Table 3.1 summarises the results of this analysis showing the relationship between the number of physico-chemical variables used to predict membership of TWINSPAN end-groups and the percentage of sites that were correctly predicted.

The results show that 67% of the sites could be placed in the correct invertebrate TWINSPAN end-group using just 4 physico-chemical variables, with 5 variables giving just under 70% success in prediction (Table 3.2). This is a slightly higher level of predictive success for a smaller number of environmental variables compared to the original analysis. It is in part a reflection of the smaller number of TWINSPAN end-groups used in the analysis. The final column in Table 3.2 shows the environmental variables used in the original MDA analysis.

Table 3.1 Revised canal macroinvertebrate dataset: summary data showing proportion of sites predicted to the correct TWINSPAN end-group using MDA with different numbers of physical variables.

Number of variables used in prediction	8	7	5	4
Number of discriminant functions used	4	4	4	4
Percent of sites assigned to the correct classification group	84%	71%	69%	67%

Table 3.2 Environmental variables used to predict site membership of TWINSPAN end-groups in revised MDA analysis

	Number of environmental variables used				Variables previously used
	4	5	7	8	
Environmental variable					
Easting					+
Northing	+	+	+	+	+
Altitude	+	+	+		+
Alkalinity					+
Turbidity		+	+	+	
Boat traffic	+	+	+		+
% Sand	+	+			+
% Pebbles				+	
% Fine organic material			+	+	
% Coarse organic material			+	+	
% Bank reinforced				+	
Chloride concentration				+	
Potassium concentration			+	+	
Angle of bank at edge				+	
	67	**69***	71	84	70

* = set of variables used in MDA analysis

There was little change in the main environmental variables used in predicting invertebrate end-group membership. It was possible to omit one chemical measurement (alkalinity) and one of the locational variables (easting) neither of which contributed significantly to the predictive ability of the revised analysis. The final selection environmental variables is highlighted in bold in Table 3.2. Note that with the addition of some water chemistry parameters (chloride, potassium) and bank angle it was possible to increase the success of prediction to a maximum of 84%.

The final choice of predictive variables incoporated location, water turbidity, boat traffic and substrate type. Of these, location (i.e.northing and altitude) are invariant and need only be assessed once. As before, boat traffic data are annual figures derived from British Waterways or other canal companies. They are also relatively invarient and need only be reassessed once every five years or so unless conditions change significantly (e.g. major canal refurbishment). The two remaining categories of variable, turbidity and bottom substrate composition, require on-site field measurement when each assessment is made.

3.4 Identification of metrics using the revised invertebrate data set

Revised potential metrics based only on edge data showed broadly the same pattern of relationships with environmental data as in the original analysis (Table 3.3). All four of the originally selected metrics, ASPT, EPT, number of invertebrate families and number of Coleoptera families, showed essentially the same relationships with environmental variables. Table 3.3 summarises the analysis and a full list of potential metric relationships is given in Appendix 5.

ASPT score again correlated strongly with a variety of water quality parameters, including heavy metals, ammonia and chemical water quality class as measured by the Environment Agency (based on suspended solids, BOD and ammonia concentrations). As before ASPT showed no relationship with bank degradation. EPT attributes (EPT species and family richness) showed similar relationships to ASPT. As in the previous analysis there were some relationships with bank type and boat traffic.

Total invertebrate family richness remained strongly related to structural components with only turbidity reflecting aspects of water quality. Coleoptera family richness showed similar relationships to total invertebrate family richness.

Using the revised data set it was, therefore, possible to retain the originally selected metrics:

- ASPT — Average Score Per Taxon
- F_EPT — Number of Ephemeroptera + Plecoptera + Trichoptera families
- INV_NFA — Total number of invertebrate families
- F_COL — Number of Coleoptera families.

Table 3.3 Examples of revised canal metrics which have significant relationships with environmental degradation. Metrics shown

Potential metric	Environmental factors correlated with potential metrics
Invertebrate species richness and SRS	Bank composition; bank angle; vegetation abundance; boat traffic; turbidity; suspended solids, water depth.
Invertebrate family richness	Bank composition; bank angle; vegetation cover; boat traffic; turbidity; suspended solids; water depth.
Snail species and family richness	Bank composition; bank angle; vegetation cover; turbidity, water depth.
Leech species & family richness	Vegetation cover.
Crustacean+molluscan spp. richness	Bank composition; vegetation cover; bank angle; bank shade; water depth.
Dragonfly spp. richness	Vegetation cover; turbidity; boat traffic.
Dragonfly family richness	Vegetation cover; turbidity.
Coenagrionidae species richness	Vegetation; turbidity; sediment depth; boat traffic.
Mayfly species *and* family richness	Boat traffic; turbidity; suspended solids; sediment; Environment Agency chemical water quality class; sediment barium concentration.
Bug species richness and family richness	Altitude; bank composition; bank angle; vegetation cover; boat traffic; turbidity.
Beetle species richness	Bank composition; fine sediment; bank angle; vegetation cover; boat traffic; turbidity; sediment barium and copper concentration.
Haliplidae species richness	Bank composition; fine sediment; vegetation cover; boat traffic; turbidity; sediment phenols; Environment Agency chemical water quality class.
Hydrophilidae species richness	Bank composition; bank angle; water depth at edge; coarse sediment; vegetation cover; boat traffic.
Beetle family richness	Bank composition; bank angle; vegetation cover; turbidity; water depth at edge; boat traffic.
Alderfly species richness	Bank composition; vegetation cover; boat traffic; turbidity; suspended solids.
Caddisfly species richness	Vegetation cover; substrate composition;
Caddisfly family richness	Bank composition; turbidity; potassium; sodium; sediment phenol concentration; Environment Agency chemical water quality class.
Leptoceridae species richness	Bank composition; vegetation cover; boat traffic; turbidity; chloride; sodium; potassium; suspended solids; Environment Agency chemical water quality class; sediment phenol concentration.
Limnephilidae species richness	Bank composition; bank angle; vegetation cover; water depth; sodium; potassium; Environment Agency chemical water quality class; sediment chromium concentration

Table 3.3 (continued) Examples of revised canal metrics which have significant relationships with environmental degradation[1]

Potential metric	Environmental factors correlated with potential metrics
BMWP score	Altitude, bank composition; vegetation; water depth, boat traffic; turbidity; phenols; suspended solids; potassium; Environment Agency chemical water quality class; aluminium; iron; lead; sodium; sediment thallium and tungsten concentration.
ASPT	Potassium; sodium; ammonia; Environment Agency chemical water quality class; sediment arsenic, antimony, chromium and tin concentrations.
EPT species richness	Bank composition; boat traffic; turbidity; ammonia; sodium; potassium; sediment phenol and barium concentration; suspended solids; Environment Agency chemical water quality class.
EPT family richness	Bank composition; turbidity; boat traffic; sediment barium and phenol concentration; suspended solids; ammonia; sodium; potassium; Environment Agency chemical water quality class.
ETO species richness	Bank composition; boat traffic; turbidity; ammonia; sodium; potassium, sediment barium and phenol concentration; suspended solids; Environment Agency chemical water quality class.
ETO family richness	Bank composition; vegetation; boat traffic; turbidity; ammonia; sediment barium and phenol concentration; suspended solids; Environment Agency chemical water quality class.
OM family richness	Bank composition; vegetation; boat traffic; turbidity; suspended solids.
EMO family richness	Vegetation; boat traffic; turbidity; suspended sediment; Environment Agency chemical water quality class.

[1]All correlations significant at $p<0.001$.

3.5 Case studies

The case studies undertaken to make initial tests of the effectiveness of Canal PSYM were repeated using the revised dataset. The two case studies were:

1. Use of canal invertebrate IBIs to describe the ecological integrity of canals.
2. Use of canal metrics to distinguish the effects of water quality and bank structure.

Case study 1. Use of canal invertebrate IBIs to describe the ecological integrity of canals.

In the first canal trial, an overall assessment of the method was undertaken using two groups of sites: canals which had clearly degraded water quality and minimally impaired sites. Canals were assessed on the basis of the four priority invertebrate metrics i.e.: ASPT EQI, EPT EQI, number of families EQI (NFAM) and number of Coleoptera families EQI (NCOL) (Table 3.4).

The five degraded canals were located in the West Midlands and Hertfordshire and were all classified by the Environment Agency as having a chemical water quality of E or F. The IBI of these sites ranged from 2 to 3 (out of a total of 12) i.e. between 17% and 25% of the score which would be expected from a minimally impaired site. In the original analysis the same sites varied from 13% to 25% of the minimally impaired value.

Table 3.4 Trial IBI (Index of Biotic Integrity) for impaired and minimally impaired canals using revised canal invertebrate dataset

Site no.	Canal	ASPT EQI		EPT EQI		NFAM EQI		NCOL EQI		**IBI score**	**IBI % of un-impaired score**	
											Edge only PSYM	Edge + Deep PSYM
'Impaired'												
43	Birmingham	0.59	2	0	0	0.21	0	0	0	**2**	**17%**	13%
39	Birmingham	0.59	2	0	0	0.26	1	0	0	**3**	**25%**	19%
38	Birmingham	0.61	2	0	0	0.34	1	0	0	**3**	**25%**	25%
40	Birmingham	0.70	2	0	0	0.34	1	0	0	**3**	**25%**	25%
19	Grand Union	0.77	3	0	0	0.23	0	0	0	**3**	**25%**	25%
'Minimally impaired'												
		ASPT EQI		EPT EQI		NFAM EQI		NCOL EQI		**IBI score**	**IBI % of un-impaired score**	
											Edge only PSYM	Edge + Deep PSYM
48	Basingstoke	0.90	3	0.77	3	0.93	3	1.04	3	**12**	**100%**	100%
50	Basingstoke	0.88	3	0.73	2	0.76	3	0.76	3	**11**	**92%**	100%
51	Basingstoke	0.90	3	0.62	2	1.00	3	0.78	3	**11**	**92%**	100%
86	Chesterfield	0.96	3	0.96	3	0.54	2	0.55	2	**10**	**83%**	83%
113	Leven	1.04	3	1.32	3	1.08	3	0.82	3	**12**	**100%**	100%

The high quality sites were from the Basingstoke, Chesterfield and Leven canals and were all classified as either chemical Class A or B. These sites had IBI scores which ranged from 10 to 12 i.e. scores between 83% and 100% of the total which would be expected from a minimally impaired canal. In the original analysis these sites showed the same range of percentage scores (Table 3.4).

Case study 2. Use of canal metrics to distinguish the effects of water quality and bank structure.

The analysis to investigate the relative performance of canal water quality and bank quality metrics was repeated using the revised dataset. This anslysis used 'replicate' invertebrate samples taken from a number of canal locations which had contrasting bank characteristics: either natural (100% earth) or reinforced (75-100% steel or concrete) banks. This gave pairs of samples which were collected under the same chemical quality conditions, but which had contrasting levels of bank structure impairment.

The four canal invertebrate metric EQIs were calculated for each pair of sites (ASPT EQI, EPT EQI, number of invertebrate families EQI (NFAM) and number of Coleoptera families EQI (NCOL) (Table 3.5). The final column in Table 3.5 shows the original values of the percentage IBI based on PSYM using combined edge/deep water invertebrate data.

Re-analysis of the data did not substantially alter the resuls of the comparison. A number of sites showed minor changes in values but all sites showed the same relationship as in the previous analysis (i.e. natural banks normally had higher overall scores than reinforced banks). Sites which were previosuly noted as anomalous (42 / 43, 85 / 86, 101 / 102, 111 / 112) again showed the same trend.

As noted in Williams et al (2000) Sites 42 and 43 had a very low ASPT.EQI probably because of the very poor water quality at this site. This was probably the result of a relationship between ASPT and family richness. At sites with very low numbers of invertebrates (around 8 families in total) ASPT scores become rather variable, and therefore unreliable.

The remaining three anomlaous sites all had dense growths of filamentous algae on reinforced margins which provided an effective alternative habitat to natural banks and emergent plants. As a consequence of this, reinforced bank habitats were richer than would generally be expected.

Table 3.5 Comparison of IBI scores from 'replicate' canal sites with natural and reinforced banks

Site no.	Canal	Bank type*	Water Quality Scores: ASPT EQI	EPT EQI	**Total water quality**	Bank Quality Scores: NFAM EQI	NCOL EQI	**Total Bank Quality**	**Index of Biotic Integrity: IBI score**	**IBI % of unimpaired score: New analysis**	IBI % of unimpaired score: Previous analysis
12	Oxford	Re	3	1	**4**	0	2	**2**	**6**	**50%**	75%
13		Nat	3	3	**6**	2	3	**5**	**11**	**92%**	100%
17	Grand	Re	3	2	**5**	0	1	**1**	**6**	**50%**	58%
18	Union	Nat	3	3	**6**	3	3	**6**	**12**	**100%**	92%
33	Wyrley &	Re	3	1	**4**	0	1	**1**	**5**	**42%**	67%
34	Essington	Nat	3	3	**6**	3	2	**5**	**11**	**92%**	92%
43	Birmingham	Re	2	0	**2**	0	0	**0**	**2**	**17%**	17%
42		Nat	3	0	**3**	2	2	**4**	**7**	**58%**	75%
49	Basingstoke	Re	3	2	**5**	2	2	**4**	**9**	**75%**	83%
50		Nat	3	2	**5**	3	3	**6**	**11**	**92%**	100%
66	Shropshire	Re	3	3	**6**	0	1	**1**	**7**	**58%**	67%
65	Union	Nat	3	2	**5**	2	1	**3**	**8**	**67%**	75%
77	Trent and	Re	3	2	**5**	1	1	**2**	**7**	**58%**	67%
76	Mersey	Nat	3	1	**4**	3	3	**6**	**10**	**83%**	75%
82	Basingstoke	Re	3	2	**5**	1	3	**4**	**9**	**75%**	83%
83		Nat	3	3	**6**	3	3	**6**	**12**	**100%**	100%
86	Chesterfield	Re	3	3	**6**	2	2	**4**	**10**	**83%**	83%
85		Nat	3	3	**6**	1	2	**3**	**9**	**75%**	67%
96	Peak Forest	Re	3	1	**4**	0	0	**0**	**4**	**33%**	33%
97		Nat	3	1	**4**	0	1	**1**	**5**	**42%**	58%
101	Lancaster	Re	3	3	**6**	3	3	**6**	**12**	**100%**	100%
102		Nat	3	3	**6**	3	3	**6**	**12**	**100%**	100%
105	Ashby	Re	3	3	**6**	1	2	**3**	**9**	**75%**	67%
104		Nat	3	3	**6**	2	3	**5**	**11**	**92%**	83%
107	Leeds-	Re	3	3	**6**	0	3	**3**	**9**	**75%**	83%
108	Liverpool	Nat	3	3	**6**	2	3	**5**	**11**	**92%**	100%
111	Pocklington	Re	3	3	**6**	2	3	**5**	**11**	**92%**	92%
112		Nat	3	3	**6**	3	3	**6**	**12**	**100%**	100%

Bank types*: Re = Reinforced; Nat = Natural

5. Conclusions

5.1 Changes resulting from the use of edge habitat data only

5.1.1 Prediction of canal invertebrate assemblages

PSYM predictive equations using the revised edge sample datasets were constructed with a data set of 45 minimally degraded sites, 2 sites used in the original analysis being omitted (Sites 63 and 70).

The resulting TWINSPAN classification and MDA analysis showed little difference from the original combined sample PSYM. Five, as opposed to the original six, environmental variables were used for end-group prediction with 69% success in allocating sites to the correct end-groups, compared to 70% in the previous analysis.

For PSYM based on edge samples it was possible to omit alkalinity as a predictor. In general it is desirable to remove chemical determinands as predictors since these are often altered by anthropogenic impacts.

5.1.2 Development of metrics

Re-assessment of potential invertebrate metrics using edge only samples showed that essentially the same range of biological attributes had strong monotonic relationships with degradation measures as when combined samples were used.

Following re-analysis ASPT and EPT remained effective metrics for assessing water and sediment pollutants. Likewise, total invertebrate family richness and Coleoptera family richness were useful indicators of bank habitat quality.

The final choice of four metrics for monitoring canals using the revised version of PSYM was therefore unchanged and comprised:

- ASPT Average Score per Taxon.
- F_EPT Number of Ephemeroptera + Plecoptera + Trichoptera families.
- INV_NFA Total number of invertebrate families.
- F_COL Number of Coleoptera families.

5.1.3 Initial trials

In order to investigate the viability of the revised PSYM method, two trials using the canal data set were repeated.

Trial 1. Use of canal IBIs based on macroinvertebrate edge sample data

PSYM based on edge samples showed that canals from high and low water chemistry bands were clearly differenetiated in terms of IBI scores.

As in the original analysis, in chemically poor canals the lowest IBI scores obtained were between 17% and 25% of the score which would be expected from a minimally impaired site. High quality sites again had values of between 83% and 100% of the expected values.

Trial 2. Use of canal metrics based on edge only sample data to distinguish the effects of water quality and bank structure
The comparison of samples taken from hard reinforced banks and well vegetated banks at the same location was repeated to investigate the effectiveness of the revised metrics for assessing water quality and bank quality. The results were essentially the same as in the original analysis, showing the same potential to separate water quality from bank quality effects. As before, ASPT was less effective (i.e. gave more variable results) in samples with very few taxa.

5.2. Overall conclusion

Canal PSYM using edge samples alone produced results which were little different to those based on combined edge and deep water samples. For the purposes of canal quality assessment focussing on water quality the revised version of PSYM using only edge data is quite acceptable.

References

Biggs, J., Williams, P., Whitfield, M., Fox, G. and Nicolet, P. (2000). *Biological techniques of still water quality assessment 3: method development. Environment Agency*. R&D Technical Report E110. Environment Agency, Bristol.

Appendices

Appendix 1. List of sites surveyed

Appendix 2. List of taxa recorded

Appendix 3. Environmental data

Appendix 4. Correlations between potential metrics and environmental variables

Appendix 5. Species omitted from each site as a result of the removal of bottom samples