JOINT ANGLO-SOVIET BIOLOGICAL SURVEILLANCE EXERCISE ON RIVER DNIEPER (MAY 1978) – UNITED KINGDOM HYDROBIOLOGISTS' REPORT

by

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INTRODUCTION

As one part of an on-going programme concerned with environmental protection as provided for under the terms of a UK/USSR Joint Environmental Protection Agreement signed in London, 21 May 1974, a seminar – "The elaboration of the scientific basis for monitoring the quality of surface water by hydrobiological indices" was held at Valdai in Russia 12–14 July, 1976. As a continuation of this theme it was agreed that delegations of hydrobiologists from each side should carry out reciprocal visits to carry out comparative field tests on selected systems of biological surveillance in use in the respective countries. The Soviet hydrobiologists visited the UK to carry out exercises on the River Trent and some tributaries in 1977 and this is reported in another paper of this symposium. In May 1978 a team of British hydrobiologists (Appendix 1) visited the USSR, under the auspices of the Department of Environment, to carry out joint exercises on the River Dnieper and some tributaries. This paper reports the results of selected methods used by the British side when applied to the conditions found in the River Dnieper. The results of the methods used by the Soviet team on the same survey are presented in a further paper of this Symposium.

THE SURVEY PROGRAMME AND METHODS

The Survey exercise was planned by the Hydrobiological Institute, Ukrainian Academy of Sciences, Kiev, in collaboration with Hydromet – a government organisation responsible for hydrometeorological services in the USSR equivalent to the Department of the Environment. For the purpose of the exercise the River Dnieper and some of its tributaries upstream of Kiev were chosen. A sketch map of the stretches of river involved is given in Figure 1. Although regarded by the Soviet scientists as a 'medium' sized river the River Dnieper was, to us, a large continental river and even the "small" tributary rivers were equivalent to the lower reaches of our major rivers. Upstream of Kiev the Dnieper is impounded to form Kiev Reservoir, some 120 km in length.

Seven sampling stations were used in the survey as indicated on map (Figure 1):-

1. Kiev Reservoir, lower section near village of Lutezh.

2. Kiev Reservoir, middle section near Domontovsky islands.

3. Kiev Reservoir, upper section.

4. River Dnieper near village of Ossorevichy.

5. Sozh River – immediately above confluence with River Dnieper.

6. River Desna – (a major tributary of River Dnieper) immediately above confluence with River Snov.

7. River Snov — immediately above confluence with River Dnieper.

At each station samples were taken at three points across the river —

Towards the left bank	(L)
Midstream	(C)
Towards the right bank	(P).

Sampling Methods used by Soviet Team at each Station

Phytoplankton	—	The surface water was sampled directly into a bottle. A Ruttner bathometer was used to sample at depth.
Zooplankton	—	Quantitative surface samples were taken by pouring 50 L of water through a zooplankton net.
Periphyton	—	(Aufwuchs). This was sampled by scraper on any solid substratum or immersed solid surfaces such as navigation buoys or posts in midstream or vegetation in the littoral zone.
Zoobenthos	—	For quantitative samples of soft substrata Peterson grabs (0.01 and 0.025 m^2) and a Tube Corer sampler (0.01 m^2) were used. For qualitative samples a trawl was used in the deep waters midstream and handnets in the littoral zones.
Chemical	—	At each sampling point water samples were taken for analysis which for pH, CO_2, Dissolved Oxygen and BOD, was carried out immediately aboard ship. Other samples were taken back to Kiev for analysis of Nitrogen, Phosphorus, major ions and organic concentration.

Sampling Methods Used by British Team

As part of the exercise, the British team studied the methods used by the Soviet hydrobiologists by participating in the sampling. It was generally felt that biological surveillance in the USSR involves a wider range of biologist specialists — on this occasion different ones being responsible for — phytoplankton, zooplankton, periphyton and zoobenthos and others for fish, which were sampled by gill netting overnight at one station. No Water Authority in Britain could muster such a team for routine biological surveillance.

The British methods to be applied, such as the Trent Biotic Index and Chandler Score required the sampling of the macro-benthos. Because of the size and nature of the river it was obvious that the methods of sampling the macro-benthos as used in British rivers, eg, Kick-heel sampling were not applicable to the situation in the River Dnieper. Furthermore because of the very sandy nature of the river bed, benthic samples taken by grab sampler proved most unproductive of macro-invertebrate species. It was decided therefore to collect macro-invertebrates from the littoral zones at each station. At the riverine stations this also proved difficult because of the flooded conditions caused by the snow-melt. At different stations the nature of the littoral zone differed appreciably, eg concrete, sand and macrophytes. A description of the nature of the littoral zones at the different sampling stations is given in the next section.

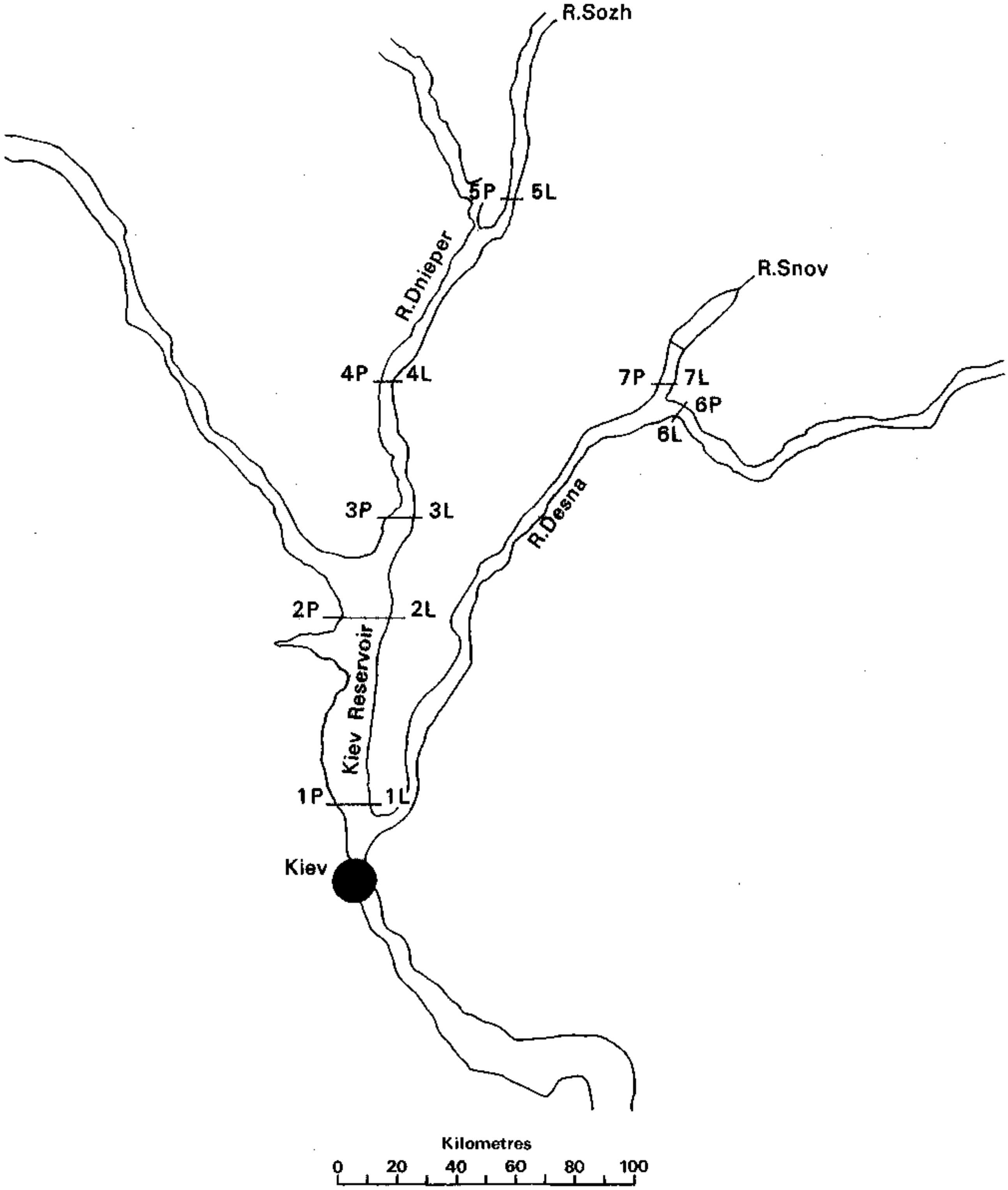

FIG.1 Sketch map of River Dnieper and Tributaries showing position of sampling stations

Cartographic Services M

At each station macro-invertebrates were collected from available biotopes present in the littoral zones using a handnet. On the sandy banks and shores which supported a very poor macro-invertebrate fauna, any solid surfaces were searched including debris, although it was appreciated that some of this could have been carried downstream by the floods. The sampling was therefore qualitative only; in processing the samples however a rough relative abundance grading (1—3—5) was attributed to the species taken.

The survey of Kiev Reservoir and the River Dnieper itself as far upstream as the confluence of the tributary River Sozh, some 200 km upstream of Kiev, was carried out from the Institute's survey vessel "A V Topachevsky" (named after the former Director of the Institute). She carried two launches from which the sampling was carried out. The macro-invertebrate samples were processed in the laboratory aboard the survey vessel. The survey of the River Dnieper took place over a four-day period. The samples from the tributary River Desna and its tributary the River Snov were taken using a smaller vessel during a further day's excursion from Chernigov.

Description of Littoral Sampling Sites

1. Kiev Reservoir — Lower Section

1.L **Left Bank** — This bank, just upstream of the reservoir dam, is entirely reinforced by concrete slabs which were coated with an algal film. In the littoral zone there was building rubble which was encrusted with *Dreissena.*

1.P **Right Bank** — Sandy bank suffering erosion, littoral zone sandy-silt.

2. Kiev Reservoir — Middle Section

2.L **Left Bank** — Banks covered with pine woods which reached down to the water's edge. There was thin brushwoods of partly submerged bushes, the main type of bottom was silted sand.

2.P **Right Bank** — The littoral zone here was a system of small islands which were covered by *Phragmites.* Pinewoods and meadows with rich meadow vegetation reached down to the water's edge and under the flood conditions prevailing, these penetrated the littoral zone. The main type of substratum was silted sand.

3. Kiev Reservoir — Top Section

3.L **Left Bank** — The left side of the reservoir here is shallow and merges with extensive low-lying meadow land. As a result there are many meadow pools and at the time of sampling much flooded meadow.

3.P **Right Bank** — On this side also meadow land with well developed vegetation reached down into the littoral zone. There were also many temporary pools in the nearby meadow land.

4. River Dnieper upstream of Kiev Reservoir near village of Ossorevichy

4.L **Left Bank** — The bank was covered with a *Salix* thicket which under the flood conditions was partly submerged. The substratum was silted sand.

4.P **Right Bank** — The littoral zone consisted of flooded meadow land. Substratum in river bed was silted sand.

5. R Sozh – Immediately above confluence with R Dnieper

5.L **Left Bank** – This was gently sloping forming sandy beaches part of which were colonised by *Salix*. Under the flood conditions these were partly submerged. The current was slack allowing deposition of silt on the sand.

5.P **Right Bank** – The current on this side of the river was much more rapid (0.2 m/sec) and the high banks were seriously eroded and overhanging in places. In the water there was some fallen trees and vegetation as a result of the collapse of the banks.

6. R Desna – (Tributary of R Dnieper) – Immediately upstream of the confluence with its tributary – the R Snov

Very strong current mid-stream.

6.L **Left Bank** – Substratum of fine mud and silted sand. Bushes partly submerged and detached tree branches carried down by floods. No true aquatic macrophytes.

6.P **Right Bank** – High sandy banks seriously eroded and under-cut and had collapsed into river in places causing partly submerged fallen trees to be present along the banks. Beyond the banks low lying meadow land seriously flooded creating temporary pools.

7. River Snov (Tributary of River Desna) Immediately upstream of confluence with River Desna

7.L **Left Bank** – Gently sloping bank with rich meadow vegetation reaching into littoral zone under flooded conditions. Temporary pools formed on meadow land.
A well developed submerged macrophyte flora – *Elodea, Potamogeton* and *Equisetum* was present in the true littoral zone.

7.P **Right Bank** – The banks here were higher and were eroded.

During the River Desna survey an alleged pollution of the River Snov, some kilometres upstream of the confluence, by a flooded refuse tip, was investigated. Samples were taken in the vicinity of the tip but no ecological effects were detected.

RESULTS

The results of the sampling at the five stations on the Dnieper (1–5) and the two stations on the Desna (6 and 7) are given respectively in Tables 1 and 2. These results were processed to derive the different Water Quality Indexes which it was planned to test –

- Trent Biotic Index (Original and Extended)
- Chandler Score
- Department of the Environment (BMWG) Score.

The tables for deriving these indexes are given respectively in Appendix 2. The results are summarised in Table 3 and Figure 2.

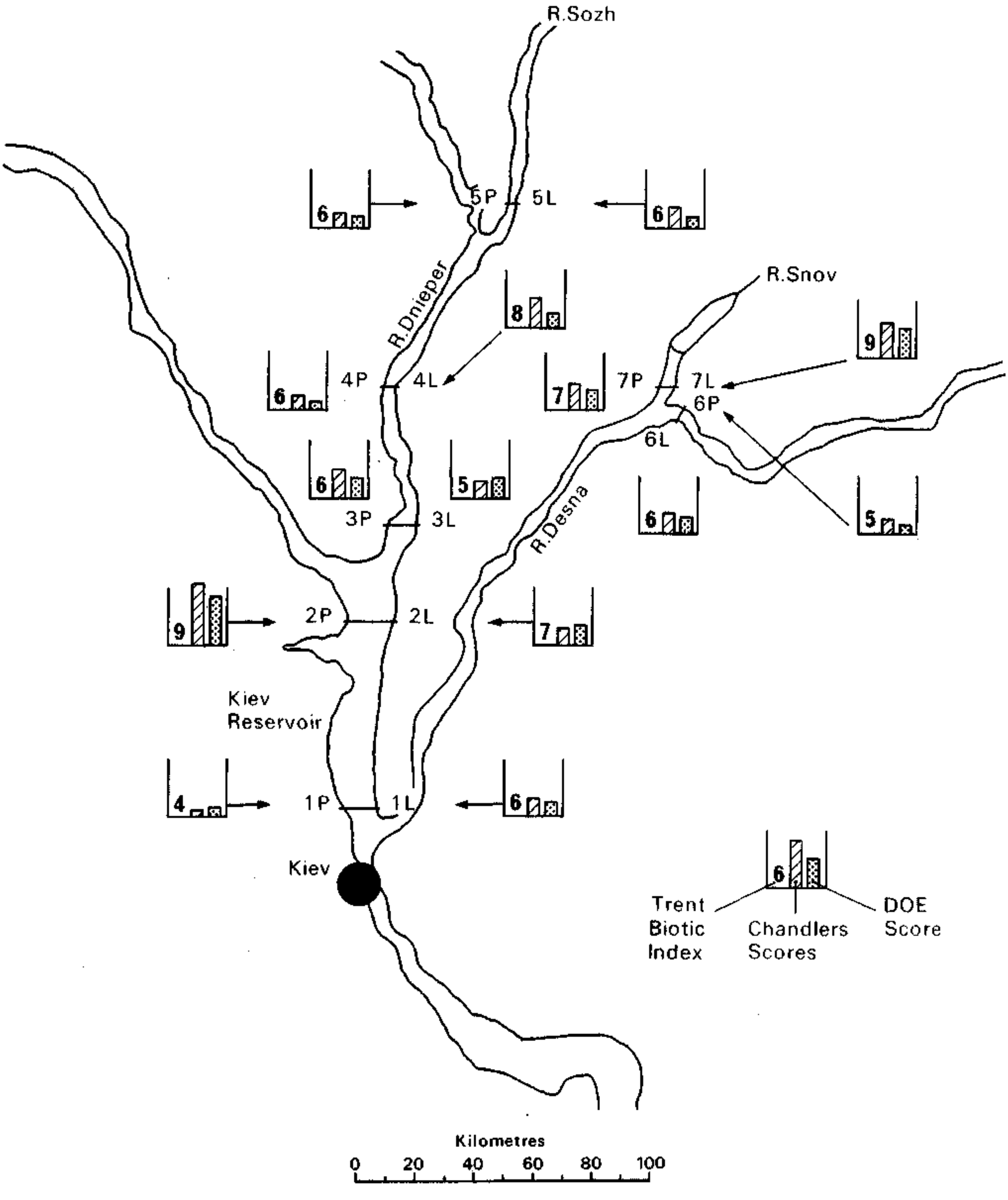

FIG.2 Diagrammatic representation of different British Water Quality Indexes as applied to R.Dnieper and Tributaries

Cartographic Services MS

The data collected was not, in all respects, appropriate for the above methods of processing. All the above methods depend upon the recognised tolerance of commonly occurring British species to organic pollution.

Although many of the species found were common to the British fauna, some were not. The Chandler Score makes use of the relative abundance of the organisms present and therefore requires at least semi-quantitative data. As explained in the Methods section, because of the nature of the substrata, quantitative sampling was not practicable. The approximate relative abundance rating (1, 3, 5) attributed to the species was used in deriving the Chandler Score; the equivalents being 1 – P (present) 3 – C (common), 5 – V (very abundant). Because the relative abundance rating has only a slight effect on the Chandler Score (Appendix 2b) this approximation should not have a marked effect on the Score values. The proposed Department of Environmental (Biological Monitoring Working Group) Score is based on the relative tolerance to pollution at family level, this being determined by the most tolerant species in the family. This score therefore tends to underestimate water quality; it was considered better to err on the safe side rather than risk the possibility of overestimating by deriving the score from the most sensitive species. The Department of the Environment Score differs from others in attempting to recognise different types of substratum – eroding and depositing. For the data in the present work, because of the nature of the rivers sampled the depositing substratum score was used. In Table 4 the stations are ranked according to the different indexes used. Chemical data, supplied by the Soviet team is presented in Table 5.

DISCUSSION

During the course of the survey no discharge of effluent to the river was observed. The results cannot therefore be considered in relation to specific point sources of pollution. It was understood that the main pollutional load to the river was from agriculture. It was subsequently learnt that the effluent from a cattle-breeding farm discharged directly to the river from the right hand bank of the Dnieper immediately upstream of station 4P. Examination of the available chemical data (Table 5) reveals no apparent trend in water quality, the oxygen concentration would appear to be satisfactory at all stations with the possible exception of 3P.

It may be significant that Station 4P – the one immediately downstream of the farm effluent – had the lowest Department of Environment score and the next to the lowest Chandler Score. The presence of nymphs of the mayfly *Caenis* however results in a TBI of 6 which on this basis puts the station towards the middle of the ranking order (Table 4).

The most significant feature of the biological results is that in spite of the lack of evidence of marked differences in water quality both in terms of the chemical data available and known sources of pollution, there were marked differences in the indexes and scores between stations. The TBI ranging from 4 to 9 (10 extend the Chandler Score from 121 to 1069) and the Department of Environment (BMWG) Score from 125 to 875. Apart from the River Snov being superior to the River Desna, on all scores, the differences were not evidently related to different sections of the rivers or tributaries, marked differences occurring between the values from the right and left banks at the same station.

Examination of Table 4 shows a close similarity of the ranking orders as indicated by the different systems used. The top two stations 2P and 7L are so indicated by all three systems. Although the grouping together of several stations with the same TBI make critical comparisons impossible, it will be seen that ten of the fourteen stations are in the same ranking order in the TBI and Chandler Score, the other four being in the next rank order. On the same basis although nine of the stations are in the same order of ranking with TBI and Department of Environment Score, several of these which were not, ie 3P, 4L and 4P were not even in the next ranking order. Because only two stations were grouped in the score systems (3P and 7P) a more critical comparison could be made between the respective rankings for the two Score Systems. At this critical level of comparison ten stations have similar ranking orders or in the next rank order. The others, however, were quite different in their ranking.

Of the systems tested the Department of Environment Score System should be the most appropriate since it takes into account the depositing substratum taxa such as the Odonata and Hemiptera. The higher relative ranking of Station 3L by the Department of Environment Score, for example, is partly due to the presence of the Coenagriidae, Gerridae and Corixidae which together contributed 100 points to the Department of Environment Score but 0 points to the Chandler Score which was designed for eroding substratum taxa. It is significant that it was the Department of Environment Score System which indicated most positively the one known point source of pollution.

The close correlation between the results by the different systems does not however prove they are equally good at indicating water quality – ie their purpose. They may all be responding in a similar way to a determinant other than water quality. In the case of this survey there is a strong suggestion that they are responding to the different natures of the substratum at the different stations. In all three systems tested the index or score was influenced by the number of taxa present, this is probably more so in the case of the Scores than for the TBI. Reference to Table 4 shows that comparing the ranking of the stations according to the numbers of taxa found gives a similar ranking to that using the Department of Environment Score. The number of taxa at any station is largely determined by the nature of the substratum and the variety of biotopes present at the station. Reference to the site descriptions and the number of taxa taken at the respective stations highlights this relationship. The two stations with well-developed beds of aquatic macrophytes (2P and 7L) had the highest numbers of taxa. On the other hand, the ones described as being of eroding sandy banks (1P, 5P, 6P and 7P) had the lower numbers of taxa. Other stations with sloping beaches with vegetations reaching down into the littoral zone had an intermediate number of taxa. The one exception was 4P which had the lowest number of taxa, probably due to the farm effluent immediately upstream.

Besides affecting the overall number of taxa, the substrate type was also important in determining the incidence of specific taxa. Silty sand which dominated the substratum at many stations did not provide suitable habitat niches for many species. Ephemeroptera and Trichoptera, for example, were noticeably absent at a number of such stations. In areas where the substratum was more heterogeneous, the diversity of macroinvertebrate species increased noticeably. Individual species also increased in numbers under these conditions, eg on the left bank at Site I (IL) the natural substratum had been modified by building slag and bricks from the concrete dam construction. Here a large population of *Dreissena polymorpha* and *D.bugensis* flourished, since the substratum was suitable for their particular mode of attachment. At site 2P (the Domontovsky Islands) an emergent littoral vegetation composed primarily of *Phragmites* sp. was present, and in this region 31 taxa were recorded including three ephemeropteran species, four cased trichopteran species (three leptocerid ones) and eight molluscan taxa. Adults of the net-spinning trichopteran species *Cyrnus flavidus* were also recorded at this locality. The left bank at site 2L also produced the only plecopteran species (*Isoperla* type) to be recorded during the whole duration of the exercise.

During the evening of May 16, an extensive hatch of the leptocerid caddis *Ceraclea nigronervosa* was recorded aboard the A V Topachevsky, near the top end of Kiev Reservoir. Since larvae of this species seem to require sponge in their diet in order to complete their life cycles (Morse and Wallace 1974), it is suggested that the upper reaches at least of the reservoir, probably have abundant growths of sponge on submerged wood; the latter probably a legacy of the original impoundment scheme. British populations of *C. nigronervosa* are always found on sponge (Resh, Morse and Wallace, 1976) indicating that the species is probably an obligate sponge-feeder.

At the site 3 (3L and 3P) stations the habitat was dominated by water meadows with well developed emergent vegetation. These floodlands also contained numerous small water bodies. Ephemeropteran species present included *Baetis, Cloeon* and *Caenis,* and the cased trichopteran species *Anabolia* sp. and *Triaenodes* sp. were also recorded. Adults of *Agrypnia pagetana* (a phryganeid Trichoptera species) were also caught in large numbers on the left bank of the River Dnieper just above the reservoir. It is interesting to note that Bray (1966) records this species from large lakes with well developed emergent vegetation in Britain.

On the right bank of the River Desna (6P) just above it confluence with the Snov, very large numbers of Simuliidae and a polycentropodid species were found on submerged tree roots. Both taxa are filter feeders, and there may have been a source of organic particulate material upstream. The occurrence of these taxa again illustrates the limiting nature of the substratum in the main channel of the Desna, in which only three chironomid species were recorded. Due to the high water levels caused by snow melt at all sampling sites, littoral hand net sweeps were difficult to take. However, it was noticeable that the flooded grass margins of the Snov contained numbers of *Anabolia sp.* (Trichoptera: Limnephilidae) together with *Cloeon* and *Coenagrion* species. Macan (1963) after reviewing the importance of current velocity and nature of substratum as determinants of benthic macroinvertebrate communities in flowing waters concludes that current velocity determines the composition of zoocoenoses through its effect on the bottom and on the plant communities. Hynes (1960) distinguishes between the eroding and depositing substrate fauna in rivers and considers sand to be inhospitable to most forms. Many species however require extensive hard surfaces either for attachment, movement, grazing or reproduction. The availability of such surfaces either as macrophytes or submerged objects in slow flowing or lenthic waters enables many taxa to be present which do not colonize the depositing substratum itself.

The quantitative and qualitative differences in the benthic macroinvertebrate fauna at the different stations is therefore the result of differences in the nature of the substratum at the respective stations. Both quantitative and qualitative differences in the fauna affect the TBI and the Scores. It would appear probable therefore that the different indexes and scores derived for the several stations reflect more the differences in the substratum at the different stations than differences in water quality. The low values for station 4P were the exception, as these probably indicated the deterioration in water quality below the farm effluent.

It must be concluded therefore that for biological surveillance of water quality in rivers such as the Dnieper, the systems, such as those used for British rivers which are based on the natural benthic macroinvertebrate fauna, are inappropriate. The surveillance of such communities may however be appropriate for other purposes, such as monitoring changes in the benthic deposits especially following the impoundment of a river as in the case of Kiev Reservoir or other changes in the flow regime.

Since benthic invertebrates are sensitive to changes in water quality, their use in biological surveillance in such rivers as the Dnieper could be made possible by the use of artificial substrate samplers such as the S.Auf.U. sampler developed for use in national surveys in British rivers (Girton and Hawkes, 1979). The use of such standard substratum samplers would overcome the problem of the variability of natural substrate types in rivers such as the Dnieper.

It may well be that although in the smaller fast flowing British rivers benthic communities have proved most successful in biological surveillance work, in the large continental rivers the use of periphyton or plankton could be more appropriate. In which case the Saprobic System of classification which is applicable to a range of communities would be most appropriate. The Saprobic System would, of course, be equally applicable to benthic macro-invertebrate communities found in British rivers.

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the Department of Environment for inviting them to participate in the exercise and also to their respective authorities for granting them leave of absence to do so.

We are grateful to Dr P C Barnard of the British Museum (Natural History) for verifying the identification of adult Trichoptera material.

Finally to our Soviet hosts, our sincere thanks for making our visit such a happy and memorable one.

APPENDIX 1

List of British team involved in the Joint Anglo-Soviet Biological Surveillance Exercise on River Dnieper (May, 1978).

Mr H A Hawkes, Leader	–	Department of Biological Sciences University of Aston in Birmingham
Mr G Fretwell	–	Severn Trent Water Authority
Mr R A Jenkins	–	Welsh Water Authority (South West Wales River Division)
Dr J B Leeming	–	North West Water Authority
Mr D J Lowson	–	Forth River Purification Board.

APPENDIX 2

Tables for deriving Indexes and Scores as used on British Rivers.

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TABLE 1 Macro-invertebrates found in littoral zones of the Kiev Reservoir, R. Dnieper and R. Sozh (May 1978)

Relative abundance

(1) - Rare
(3) - Occasional
(5) - Abundant

L - Left Bank
P - Right Bank

Taxa	1 Kiev Res. Lower		2 Kiev Res. Middle		3 Kiev Res. Upper		4 R. Dnieper		5 R. Sozh	
	L	P	L	P	L	P	L	P	L	P
MOLLUSCA										
Viviparus viviparus	(1)	(1)	(5)	(5)	(5)	(1)			(1)	
Bithynia				(1)		(1)				
Lymnaea				(1)		(1)	(1)			
Valvata sp.	(1)									
Physa						(1)				
Planorbis	(1)			(3)		(1)				
Succinea				(1)		(1)	(1)			
Lithoglyphus naticodes					(1)				(1)	
Anodonta	(1)	(1)		(1)						
Sphaerium				(1)	(1)					
Pisidium										
Dreissena polymorpha	(5)			(1)	(1)					
" *bugensis*	(5)									
ANNELIDA										
Tubificidae	(1)		(1)		(1)		(1)			
Limnodrilus		(1)								
Lumbricidae (*Eisenia*)										
Piscicola geometra				(1)						
Hemiclepsis marginata				(1)						
Glossiphonia heteroclita						(1)				
Erpobdella octoculata	(3)			(1)		(1)			(1)	(1)
ARTHROPODA										
Hydracarina						(1)	(1)			
Argyroneta aquatica						(1)				
Corophium curvispinum	(3)									
Pontogammarus	(3)	(1)	(1)	(3)	(1)	(1)	(1)			(1)
Asellus aquaticus	(1)		(1)	(3)	(1)	(1)			(1)	
Austropotamobius (Astacus) pallipes	(1)		(1)	(3)						
Insecta										
Baetis sp.							(1)	(1)	(1)	(3)
Cloeon				(3)			(1)			
Heptagenia				(3)						
Caenis				(1)				(1)		
Isoperla			(1)							
Coenagriidae				(3)	(1)	(1)	(1)			

.../ Continued ..

TABLE 1 (Continued)

Macro-invertebrates found in littoral zones of the Kiev Reservoir, R. Dnieper and R. Sozh (May 1978)

Taxa	1 Kiev Res.		2 Kiev Res.		3 Kiev Res.		4 R. Dnieper		5 R. Sozh	
	L	P	L	P	L	P	L	P	L	P
Insecta (continued)										
Aeshnidae				(1)	(1)					
Gerridae										
Corixidae *(Sigara)*		(3)		(1)	(1)	(1)			(1)	(1)
Ilyocoris				(1)						
Haliplus				(1)			(1)		(1)	
Dytiscidae	(1)			(1)	(1)	(1)	(1)			
Gyrinidae							(1)			
Hydrophilidae			(1)						(1)	
Curculionidae				(1)						
Oecetis lacustris				(1)		(1)				
Triaenodes				(1)		(1)				
Oxyethira										
Limnephilidae				(1)						
Oecetis furva				(1)						
Anabolia sp.										(1)
Chironomidae		(3)	(1)	(3)		(1)	(1)	(1)	(1)	(1)
Ceratopogonidae					(1)				(1)	
Simulidae			(3)	(1)	(1)		(5)	(1)	(1)	(1)
Cryptochironomus										
Stratiomyidae						(1)				
Numbers of Taxa	(13)	(7)	(9)	(3))	(13)	(18)	(13)	(4)	(11)	(7)

TABLE 2 Macro-invertebrates found in littoral zones of the R. Desna and R. Snov (May, 1978)

Relative abundance

(1) - Rare
(3) - Occasional
(5) - Abundant

L - Left Bank

P - Right Bank

Taxa	Desna		Snov	
	L	P	L	P
Turbellaria	(1)			
Theodoxus			(3)	(1)
Viviparus	(3)		(3)	(1)
Lymnaea			(1)	
Planorbis			(1)	
Succinea			(1)	
Unio	(3)			
Tubificidae	(3)			
Glossiphonia heteroclita			(1)	
Erpobdella			(1)	
Glossiphonia sp.			(1)	
Hydracarina	(5)		(3)	(3)
Lepidurus			(1)	
Asellus		(1)	(3)	
Pontogammarus			(3)	
Cypris			(1)	
Cloeon	(3)	(1)	(5)	(3)
Caenis			(1)	(1)
Coenagriidae	(3)		(3)	
Corixidae			(3)	(3)
Dytiscidae				(1)
Gyrinidae			(3)	
Notonecta			(1)	
Ilyocoris			(3)	
Haliplidae				(3)
Paraponix stratiotata			(1)	
Anabolia sp.				(3)
Limnephilidae				(1)
Polycentropidae	(1)	(3)	(1)	
Ceratopogonidae			(1)	
Chironomidae	(3)	(1)	(1)	(3)
Simulidae	(5)	(5)		
Tabanidae	(1)			
Numbers of Taxa	(11)	(5)	(24)	(11)

TABLE 3

SUMMARY OF WATER QUALITY INDEXES DERIVED FROM INVERTEBRATE DATA FROM RIVER DNIEPER AND TRIBUTARIES (May, 1978)

	1 Kiev Res. Lower		2 Kiev Res. Middle		3 Kiev Res. Upper		4 R. Dnieper		5 R. Sozh		6 R. Desna		7 R. Snov	
	L	P	L	P	L	P	L	P	L	P	L	P	L	P
No. of Taxa	13	7	9	30	13	18	13	4	11	7	11	5	24	11
Trent Biotic Index (Extended Index)	6	4	7	9 (10)	5	6	8	6	6	6	6	5	9	7
Chandler Score	310	121	341	1069	302	501	514	203	339	266	358	242	579	442
D. of E. Score	231	156	256	875	321	335	236	125	185	200	276	135	495	335

TABLE 4

Sampling stations ranked in relation to different Indexes - Trent Biotic Index, Chandler Score Department of Environment (B.M.W.G.) Score

T. B. I.	CHANDLER SCORE	D. of E. SCORE	Nos. TAXA
2P	2P	2P	2P
7L	7L	7L	7L
4L	4L	3P)	3P
		)	
2L)	3P	7P)	1L)
)-			)
7P)	7P	3L	3L)-
			)
1L)	6L	6L	4L)
)			)
3P)	2L	2L	5L)
)			)
4P)	5L	4L	6L)
)-			)-
5L)	1L	1L	7P)
)			)
5P)	3L	5P	2L
)			
6L)	5P	5L	1P)
			)
3L)	6P	1P	5P)-
)			
6P)	4P	6P	6P
1P	1P	4P	4P

TABLE 5 CHEMICAL DATA FROM SURVEY OF R. DNIEPER AND TRIBUTARIES (MAY 1978)

		1			2			3			4			5			6			7		
		Kiev Res. Lower			Kiev Res. Middle			Kiev Res. Upper			R. Dnieper			R. Sozh			R. Desna			R. Snov		
		L	C	P	L	C	P	L	C	P	L	C	P	L	C	P	L	C	P	L	C	P
Temperature °C	S		10.1		11.5	9.1	11.5	9.5	9.5	11.0		10.9			10.2			13.8	16.1	14.7	15.5	15.9
	B		10.1			9.1			9.5													
CO_2 mg.l^-	S		35.2		17.6	27.3	19.4	35.2	22.0	35.2		35.2			57.2			30.8	9.8	35.2	52.8	35.2
	B		35.2			19.4		30.8														
O_2 mg.l^-	S		9.9		10.3	10.3	11.9	9.9	9.6	7.3		9.3			9.3			9.3	7.8	9.3	9.3	9.3
	B		9.9		10.3			8.6														
pH mg.l^-	S		7.7		7.7	7.7	7.7	7.4	7.5	7.3		7.4			7.4			7.9		7.8	7.8	7.7
	B		7.7			7.6			7.6													
BOD_5 mg.l^-	S		2.0		3.0	2.7	4.0	2.7	1.7	1.3												
	B		2.0			3.0			1.3													

L - Left Bank
C - Midstream
P - Right Bank

S - Surface
B - Bottom

TABLE 1. The Assessment of the 'Biotic Index' as used by the Trent River Board (Woodiwiss, 1964)

Clean

Organisms in order of tendency to disappear as degree of pollution increases

		Total number of groups present				
		0–1	2–5	6–10	11–15	16+
		Biotic Index				
Plecoptera	More than one species	–	7	8	9	10
nymph present	One species only	–	6	7	8	9
Ephemeroptera	More than one species*	–	6	7	8	9
nymph present	One species only*	–	5	6	7	8
Trichoptera	More than one species†	–	5	6	7	8
larvae present	One species only†	4	4	5	6	7
Gammarus	All above species	3	4	5	6	7
present	absent					6
Asellus	All above species absent	2	3	4	5	
Tubificid worm and/or Red Chironomid larvae present	All above species absent	1	2	3	4	–
All above types absent	Some organisms such as Eristalis tenax not requiring dissolved oxygen may be present.	0	1	2	–	–

Polluted

*Baetis rhodani excluded
†Baetis rhodani (Ephem.) is counted in this section for the purpose of classification

The term 'Group' used for purpose of the biotic index means any one of the species included in the following list of organisms or sets of organisms:

Each known species of Plathyhelminthes (flatworms)
Annelida (worms excluding genus Nais).
Genus Nais (worms)
Each known species of Hirudinae (leeches)
Each known species of Mollusca (snails)
Each known species of Crustacea (hog louse, shrimps)
Each known species of Plecoptera (stone-fly)
Each known genus of Ephemeroptera (may-fly, excluding Baetis rhodani)
Baetis rhodani (may-fly)
Each family of Trichoptera (caddis-fly)
Each species of Neuroptera larvae (alder-fly)
Family Chironomidae (midge larvae except Chironomus Ch. thummi)
Chironomus Ch. thummi (blood worms)
Family Simulidae (black-fly larvae)
Each known species of other fly larvae
Each known species of Coleoptera (Beetles and beetle larvae)
Each known species of Hydracarina (water mites)

TABLE 2 Classification of Biological Samples: Extended Biotic Index (Woodiwiss, 1978a).

Biogeographical Region: Midlands, England		Total number of groups present									
		0-1	2-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45
		Biotic Indices									
Plecoptera nymphs present	More than one species	-	7	8	9	10	11	12	13	14	15
	One species only.	-	6	7	8	9	10	11	12	13	14
Ephemeroptera nymphs	More than one species. *	-	6	7	8	9	10	11	12	13	14
	One species only. *	-	5	6	7	8	9	10	11	12	13
Trichoptera larvae present	More than one species. ≠	-	5	6	7	8	9	10	11	12	13
	One species only. ≠	4	4	5	6	7	8	9	10	11	12
Gammarus present	All above species absent.	3	4	5	6	7	8	9	10	11	12
Asellus present	All above species absent.	2	3	4	5	6	7	8	9	10	11
Tubificid worms and/or Red Chironomid larvae present	All above species absent.	1	2	3	4	5	6	7	8	9	10
All above types absent.	Some organisms such as Erisealis tenax not requiring dissolved oxygen may be present.	0	1	2	-	-	-	-	-	-	-

* Baetis rhodani excluded.

≠ Baetis rhodani (Emphem.) is counted in this section for the purpose of classification.

TABLE 3 BIOTIC INDEX BY THE 'SCORE' SYSTEM (Chandler, 1970)

Groups present in sample		Increasing abundance P	F	C	A	V
		Points scored				
Each species of	Planaria alpina Taenopterygidae Perlidae, Perlodidae Isoperlidae, Chloroperlidae	90	94	98	99	100
Each species of	Leuctridae, Capniidae Nemouridae (exd.Amphinemura)	84	89	94	97	98
Each species of	Ephemeroptora (exd.Baetis)	79	84	90	94	97
Each species of	Cased caddis, Megaloptora	75	80	86	91	94
Each species of	Ancylus	70	75	82	87	91
—	Rhyacophila (Trichoptera)	65	70	77	83	88
Genera of	Dicranota, Limnophora	60	65	72	78	84
Genera of	Simulium	56	61	67	73	75
Genera of	Coleoptera, Nematoda	51	55	61	66	72
—	Amphinemura (Plecoptera)	47	50	54	58	63
—	Baetis (Ephemeroptera)	44	46	48	50	52
—	Gammarus	40	40	40	40	40
Each species of	Uncased caddis (exd.Rhyacophila)	38	36	35	33	31
Each species of	Tricladida exd.P.alpina)	35	33	31	29	25
Genera of	Hydracarina	32	30	28	25	21
Each species of	Mollusca (exd.Ancylus)	30	28	25	22	18
—	Chironomids (exd.C.riparius)	28	25	21	18	15
Each species of	Glossiphonia	26	23	20	16	13
Each species of	Asellus	25	22	18	14	10
Each species of	Leech, exd. Glossiphonia, Haemopsis	24	20	16	12	8
—	Haemopsis	23	19	15	10	7
—	Tubifex sp.	22	18	13	12	9
—	Chironomus riparius	21	17	12	7	4
—	Nais	20	16	10	6	2
Each species of	Air breathing species	19	15	9	5	1
	No animal life			0		

Levels of Abundance in 'Score' System

Level	Nos. per 5 min. sample	Remarks
P-present	1 - 2	May be drift from upstream
F-few	3 - 10	Probably indigenous, but rare
C-common	11 - 50	
A-abundant	51 -100	
V-very abundant	100	

Table 4

The B.M.W.P. Score System

FAMILIES	SCORE	
	Eroding Zone	Depositing Zone
Siphlonuridae Heptageniidae Leptophlegiidae Ephermerellidea Potamanthidea Ephemeridae Taenippterygidae Leuctridae Capniidae Perlodidae Perlidae Chloroperlidae Aphelocheiridae Phryganeidae Molannidae Beraeidae Odontoceridea Leptoceridae Goeridae Lepidostamatidae Brachycentridae Sericostomatidae	80	100
Astacidae Lestidae Agriidae Gomphidae Cordulogasteridae Aeshnidae Corduliidae Libellulidae Psychomyiidae Philopotamidae	60	80
Caenidae Nemouridae Rhyacophilidae Polycentropodidae Limnephilidae	50	70
Neritidae Viviparidae Ancylidae Hydroptilidae Unionidae Corophiidae Gammaridae Platycnemididae Coenagriidae	40	40
Mesovelidae Hydrometridae Gerridae Nepidae Naucoridae Notonectidae Pleidae Corixidae Haliplidae Hygrobiidae Dytiscidae Cyrinidae Hydrophilidae Clambidae Helodidae Dryopidae Eliminthidae Chrysomelidae Curculionidae Hydropsychidae Tipulidae Simuliidae Planariidae Dendrocoelidae	30	30
Baetidae Sialidae Piscicolidae	20	20
Valvatidae Hydrobiidae Lymnaeidae Physidae Planorbidae Sphaeriidae Glossiphoniidae Hirudidae Erpobdellidae Asellidae	10	10
Chironomidae	5	5
Oligochaeta (whole class)	1	1