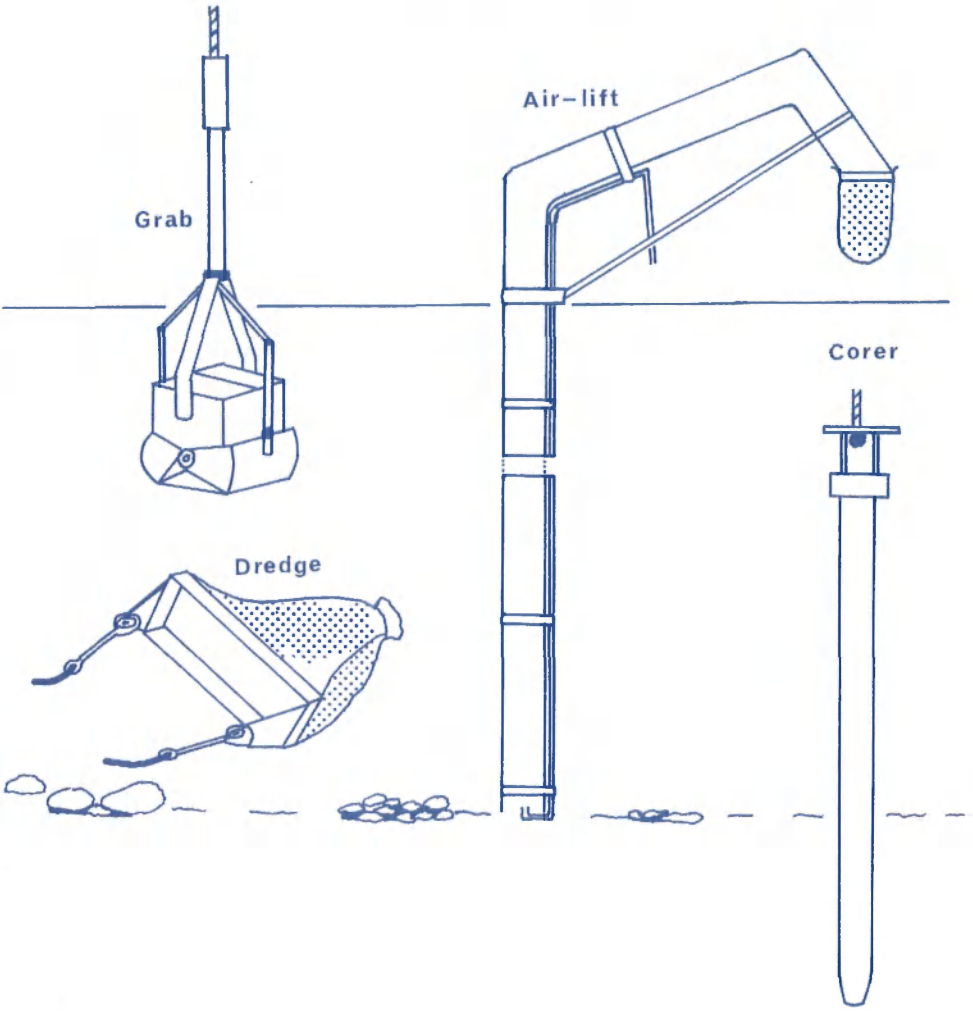
FRESHWATER BIOLOGICAL ASSOCIATION

A SUPPLEMENT TO

A BIBLIOGRAPHY OF SAMPLERS FOR BENTHIC INVERTEBRATES

J. M. ELLIOTT & P. A. TULLETT



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A SUPPLEMENT TO

A BIBLIOGRAPHY OF

SAMPLERS

FOR BENTHIC INVERTEBRATES

compiled by

J.M. Elliott & P.A. Tullett

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SUMMARY TABLE OF CLASSIFICATION OF REFERENCES ON SAMPLERS

		OPERATION		SUBSTRATUM				ORIGIN		
		S	R	M	C	L	P	Mar	FW	Total
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	2.2 Diver operated			3	5	4	3	2	4	6
3. Scoops, shovels and dredges	3.1 Scoops	7	8	9	3			7	2	9
	3.2 Shovels	9			9	9			9	9
	3.3 Dredges	3	46	45	39	14	1	36	13	49
	3.4 Anchor dredges		6	6	6			6		6
	3.5 Diver operated			1	1			1		1
4. Grabs	4.1 Ekman type		18	18	1			3	15	18
	4.2 Orange-peel type		5	5				4	1	5
	4.3 Petersen type		8	8				7	1	8
	4.4 Smith-McIntyre type		3	3	1			3		3
	4.5 Van Veen type		5	5	2			5		5
	4.6 Other grabs	4	28	29	18		4	11	21	32
	4.7 Diver operated			1				1		1
5. Corers	5.2 Small diameter < 10 cm	26	93	119	11	3		61	58	119
	5.3 Large diameter ≥ 10 cm	6	42	48	6			30	18	48
	5.4 Multiple		9	9				4	5	9
	5.5 Diver operated			7	2			2	5	7
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	6.2 Hydraulic suction samplers	1	8	9	7			7	2	9
	6.3 Air-lift samplers		7	6	6			3	4	7
	6.4 Diver operated hand suckers			4	5	5	4	5		5
	6.5 Diver operated hydraulic suction samplers			10	8	1	2	8	2	10
	6.6 Diver operated air-lift samplers			10	7	2		8	2	10
7. Electroshocking samplers		5	4	9	7	2	1	3	6	9
8. Efficiencies and comparisons								62	73	135

Introduction

This supplement to the bibliography compiled by Elliott & Tullett (1978) covers the literature from the end of November 1977 to the end of December 1982 and includes references to samplers that could be used for the rapid removal of benthic invertebrates from the natural substrata of rivers and streams. The supplement includes marine samplers that have been, or could be, used in freshwater. We will continue collecting references and will be pleased to receive copies or notifications of papers omitted and new publications.

We have seen nearly all the publications in this supplement and the brief annotations include information on sampling area, mode of operation, or any other characteristics that we consider important. References to samplers are divided into the following major categories: net and quadrat samplers; scoops, shovels and dredges; grabs; corers; suction and air-lift samplers; electroshocking samplers. They have also been classified according to the mode of operation of the sampler (S = sampler limited to shallow water of wadeable depth; D = diver-operated sampler; R = sampler operated by remote control from above water surface), the type of substratum on which the sampler can be used (M = mud and soft sediments; C = coarse gravel; L = large stones; P = macrophytes), and the origin of the sampler (Mar = marine; FW = freshwater). This classification is based on the information supplied by the authors and we have assumed that the information is correct. All the foreign titles have been translated into English.

The summary table in Elliott & Tullett (1978) has been revised to include the references in this supplement. Corrections to the original bibliography are given at the end of this supplement, together with a list of suppliers.

We are pleased to acknowledge the help of Mr J.E.M. Horne who has checked all the references and has translated the titles of Russian publications. We also thank Mrs J. Hawksford for her care and patience in typing this supplement. Most of the cost of the research involved in the preparation of this supplement has been met by the Department of the Environment as part of a contract to the Association (Contract No. DGR 480/329).

1. *REVIEWS*

1.1. FRESHWATER

Elliott, J.M., Drake, C.M. & Tullett, P.A. (1980). The choice of a suitable sampler for benthic macroinvertebrates in deep rivers. *Pollut. Rep. Dep. Environ. U.K.* No. 8, 36-44. [The advantages and disadvantages of drift samplers, emergence traps, colonization samplers, grabs, dredges, corers and air-lift samplers used for the collection of invertebrates in deep rivers (depth > 1 m) are discussed. The objectives of the investigation are the most important criteria in the choice of a sampler]

Hellawell, J.M. (1978a). A comparative review of methods of data analysis in biological surveillance. *Pollut. Rep. Dep. Environ. U.K.* No. 3, 45-57. [Compares pollution indices, diversity indices and comparative indices used in biological surveillance]

Hellawell, J.M. (1978b). *Biological surveillance of rivers.* Medmenham and Stevenage: Water Research Centre. 332 pp. [One chapter is a critical review of bottom samplers]

Rosenberg, D.M. (1978). Practical sampling of freshwater macrozoobenthos: A bibliography of useful texts, reviews, and recent papers. *Tech. Rep. Fish. mar. Serv. Can.* No. 790, 15 pp.

Simmons, G.M. (ed.) (1977). The use of underwater equipment in freshwater research. *Spec. Sea Grant Rep. Va Polytechnic Inst.* VPI-SG-77-03; Blacksburg, VA(USA). [Chapters on "SCUBA, the problem solver in sampling river benthos" by W.F. Gale, "The use of underwater research equipment in temperate lakes and reservoirs" by C.I. Dubay, and, "The use of underwater research equipment in large lakes and cold water" by L.H. Somers]

1.2. MARINE

Clarke, M.R. (1977). A brief review of sampling techniques and tools of marine biology. In *A voyage of discovery* (ed. M. Angel), 439-469. Oxford. Pergamon.

Swartz, R.C. (1978). Techniques for sampling and analyzing the marine macrobenthos. *Ecological Research Series, U.S. Environmental Protection Agency.* EPA-600/3-78-030, 34 pp.

1.3. FRESHWATER/MARINE

CONCAWE (1982). Ecological monitoring of aqueous effluents from petroleum refineries. *CONCAWE Report* No. 8/82. Den Haag. 56 pp. [Sections on objectives, sampling methods, data analysis and case studies of six ecological surveys]

Elliott, J.M. & Tullett, P.A. (1978). A bibliography of samplers for benthic invertebrates. *Occ. Publs Freshwat. biol. Ass.* No. 4, 61 pp.

2. *NETS AND QUADRAT SAMPLERS*
[operated by hand]

2.1. SIMPLE

2.1 a) *Invertebrates in mud and on stones*

Brittain, J. (1978). Sparkemethoden - fordeler, ulemper og anvendelser. (The 'kick' method - advantages, limitations and applications) (In Norwegian). *Fauna, Blindern, 31,* 56-58. S, CL, FW

Doeg, T. & Lake, P.S. (1981). A technique for assessing the composition and density of the macroinvertebrate fauna of large stones in streams. *Hydrobiologia, 80,* 3-6. [Square-quadrat box sampler with sampling area of 1296 cm²] S, L, FW

Hiley, P.D., Wright, J.F. & Berrie, A.D. (1981). A new sampler for stream benthos, epiphytic macrofauna and aquatic macrophytes. *Freshwat. Biol. 11,* 79-85. ['Lambourn' sampler, a shallow water (≤ 0.5 m) quadrat box sampler with a sampling area of 0.05 m². Detachable top unit enables the sampler to be used in deeper water (up to 1 m)] S, MC, FW

Jacobi, G.Z. (1978). An inexpensive circular sampler for collecting benthic macroinvertebrates in streams. *Arch. Hydrobiol. 83,* 126-131. [Cylindrical sampler, sampling area 585 cm², with net attached (aperture 0.75 mm)] S, CL, FW

Mackie, G.L. & Bailey, R.C. (1981). An inexpensive stream bottom sampler. *J. Freshwat. Ecol. 1,* 61-69. [Cylindrical T-sampler with sampling area of 104 cm². Sampler pushed into substrate and contents are scooped by hand into a collecting net of mesh 0.5 mm] S, CL, FW

Maitland, P.S. & Morris, K.H. (1978). A multi-purpose modular limnological sampler. *Hydrobiologia, 59,* 187-195. [Modular sampler that can be converted into pond net, Surber-type sampler and quadrat frame] S, CL, FW

McNeill, W.J. (1964). A method of measuring mortality of pink salmon eggs and fry. *Fishery Bull. Fish. Wildl. Serv. U.S. 63,* 575-588. [Hydraulic pump used to free salmonid eggs and larvae inside cylindrical net or frame, similar to sampler of Hess (1941)] S, CL, FW

Methods for the Examination of Waters and Associated Materials. (1979). Methods of biological sampling: handnet sampling of aquatic benthic macroinvertebrates 1978. London. H.M.S.O. 8 pp. [Detailed description of handnet and its use for sampling in shallow water (depth < 1.5 m). Measurements, patterns and other information used in the construction of the handnet are also given] S, MCL, FW

Methods for the Examination of Waters and Associated Materials. (1982). Quantitative samplers for benthic macroinvertebrates in shallow flowing waters 1980. London. H.M.S.O. 14 pp. [Describes Surber sampler and Aston cylinder sampler and their use in shallow water (depth < 0.5 m)] S, CL, FW

2.1 b) *Invertebrates on macrophytes*

Amoros, C. (1980). A simple device for quantitative pseudoperiphyton sampling. *Hydrobiologia, 68*, 243-246. [Cylindrical sampler, internal diameter 5 cm, with clear upper tube attached to sharpened iron collar at lower end] S, P, FW

Hiley, P.D., Wright, J.F. & Berrie, A.D. (1981). A new sampler for stream benthos, epiphytic macrofauna and aquatic macrophytes. *Freshwat. Biol. 11*, 79-85. [See Section 2.1 a)] S, P, FW

Ivanov, A.A. (1982). A device for quantitative recording of phytophilic invertebrates (In Russian). *Gidrobiol. Zh., Kiev, 18*, 3, 84-86. [Quadrat sampler with serrated edge attached to horizontal screen; sampling area 0.3 m^2] S, P, FW

Stark, J.D. (1980). A cylinder sampler for collecting the invertebrate fauna from submerged aquatic vegetation. *Mauri Ora, 8*, 45-54. [Pole-mounted cylinder sampler; sampling area 0.008 m^2, with jaws at lower end. Use limited to macrophyte beds where plant growth is upright and water depth $\leq$ 4 m] R, P, FW

2.2. DIVER-OPERATED

Rabeni, C.F. & Gibbs, K.E. (1978). Comparison of two methods used by divers for sampling benthic invertebrates in deep rivers. *J. Fish. Res. Bd Can. 35*, 332-336. [Modified sampler of Hess (1941) for deep water and diver operation, sampling area 625 cm^2] D, CL, FW

Raschke, R.L. & Frey, P.J. (1981). Benthic Dome (BeD) sampler. *Progve Fish-Cult. 43*, 56-7. [Adaptation of dome sampler of Gale & Thompson 1975; sampling area 0.25 m^2; sharp stainless steel band around the lower edge cuts into the substratum] D, MCP, FW

3. *SCOOPS, SHOVELS AND DREDGES*

3.3. DREDGES

Brunel, P., Besner, M. et al (1978). Le traîneau suprabenthique Macer-GIROQ: appareil amélioré pour l'échantillonnage quantitatif étagé de la petite faune nageuse au voisinage du fond. (The Macer-GIROQ suprabenthic sled: an improved device for quantitative two-level sampling of the small swimming fauna near the bottom) (In French). *Int. Revue ges. Hydrobiol. Hydrogr. 63*, 815-829. [Sled-mounted version of bottom plankton sampler; collects benthos on surface or in water-column just above surface, weight 228 kg] R, MC, Mar

Pickup, G. (1981). A bed material sampler for use in coarse gravels and armoured riverbeds. *Tech. Bull. Br. Geomorphol. Res. Gp, 29*, 35-38. [Bucket-type "Purari" dredge with steel bars welded to circular mouth at an angle of 25°; length 1.2 m, mouth diameter 15 cm, weight 35 kg] R, MC, FW

Rodhouse, P.G. (1976). Survey of an oyster fishery with a hydraulic dredge calibrated by divers. *J. molluse. Stud. 42*, 455. [Describes hydraulic dredge] R, MCL, Mar

Shelbourne, J.E. (1957). The 1951 oyster stock in the rivers Crouch and Roach, Essex. *Fishery Invest., Lond.* Ser II, *21*, No. 2, 27 pp. [Constructed new survey dredge on skids; weight 54 kg] R, MCL, Mar

3.5. DIVER-OPERATED DREDGE

Sibert, J., Kask, B.A. & Brown, T.J. (1977). A diver-operated sled for sampling the epibenthos. *Tech. Rep. Fish. mar. Serv. Can.* No. 738, 19 pp. [Sledge-dredge that samples the water close to the bottom] D, MC, Mar

4. *GRABS*

[Samplers with jaws that are forced shut by weights, lever arms, springs, or cords]

4.1. EKMAN-TYPE

[Box-shaped sampler with two scoop-like jaws]

Bakanov, A.I. (1979). New bottom grab designs and assessment of the aggregation state of the benthos. *Hydrobiol. J. 15*, 3, 77-82. [Modified version of a Birge-Ekman grab] R, M, FW

Beattie, D.M. (1979). A modification of the Ekman-Birge bottom sampler for heavy duty. *Freshwat. Biol. 9*, 181-182. [Pole operated version of Birge-Ekman grab with improved release mechanism] R, M, FW

McIntyre, S.C. (1981). A device to facilitate the operation of an Ekman bottom grab. *J. Freshwat. Ecol. 1*, 295-298. [Frame supports grab before cocking or emptying] R, M, FW

4.6. OTHER GRABS

Dall, P.C. (1981). A new grab for the sampling of zoobenthos in the upper stony littoral zone. *Arch. Hydrobiol. 92*, 396-405. [Hand-operated semi-circular grab with a net to retain sample; sampling area 350 cm^2, sampling depth 9.2 cm, volume of sample 2028 cm^3] S, C, FW

Day, G.F. (1978). The Day grab - a simple sea-bed sampler. *Rep. Inst Oceanogr. Sci.* No. 52. R, MC, Mar

Eagle, R.A., Norton, M.G., Nunny, R.S. & Rolfe, M.S. (1978). The field assessment of effects of dumping wastes at sea: 2. Methods. *Fish. Res. tech. Rep., Lowestoft*, No. 47. [Modified axle of grab of Day (1978)] R, MC, Mar

Ott, J.A. & Losert, A. (1979). A new quantitative sampler for submerged macrophytes, especially seagrass. *Senckenbergiana marit. 11*, 39-45. ['Riedl' grab with sharpened prongs on the biting edge of both jaws; penetrates and grasps the rhizomes and roots of seagrass beds; sampling area 0.12 m^2, weight 30 kg] R, MCP, Mar

5. *CORERS*

[Tubes that are driven vertically into the sediment]

5.1. REVIEWS

Cavallin, J.E., Bemis, C.G. & Haley, S.C. (1977). The vibratory corer in offshore investigations. *Symp. Am. Soc. civ. Engrs, 1*, 308-319.

5.2. SMALL DIAMETER CORERS

[Diameter less than 10 cm]

Barton, C.E. & Burden, F.R. (1979). Modifications to the Mackereth corer. *Limnol. Oceanogr. 24*, 977-983. [Modified version of corer of Mackereth (1958)] R, M, FW

Bell, S.S. & Sherman, K.M. (1980). A field investigation of meiofaunal dispersal: Tidal resuspension and implications. *Mar. Ecol. Prog. Ser. 3*, 245-250. [Manual corer, diam. 2.5 cm, length 8 cm fixed inside an outer tube. Space between the two cylinders filled with a mixture of dry ice and acetone which freezes the contents of the inner corer. Used to study the distribution of meiofauna in shallow tidal water] S, M, Mar

Blakar, I.A. (1978). A flexible gravity corer based on a plastic funnel closing principle. *Schweiz. Z. Hydrol. 40*, 191-198. [Diameter 5.4 cm; gravity corer with replaceable barrels] R, M, FW

Dokken, Q.R., Circé, R.C. & Holmes, C.W. (1979). A portable, self supporting, hydraulic vibracorer for coring submerged, unconsolidated sediments. *J. sedim. Petrol. 49*, 658-9. [Diameter 7.5 cm, length 5.4 m; used in water up to 33.6 m in depth. Uses hydraulic jackhammer to vibrate corer into sediment] R, MC, Mar

Fuller, J.A. & Meisburger, E.P. (1982). A simple ship-based vibratory corer. *J. sedim. Petrol. 52*, 642-644. [Diameter *c.* 5 cm] R, M, FW

Lanesky, D.E., Logan, B.W., Brown, R.G. & Hine, A.C. (1979). A new approach to portable vibracoring underwater and on land. *J. sedim. Petrol. 49*, 654-657. [Diameter 7.8 cm; petrol driven motor vibrates the aluminium coring tube into sediment] R, MC, Mar

Love, F.G., Simmons, G.M., Wharton, R.A. & Parker, B.C. (1982). Methods for melting dive holes in thick ice and vibracoring beneath ice. *J. sedim. Petrol. 52*, 644-647. [Portable corer adapted from design of Lanesky et al. (1979)] R, M, FW

Meischner, D., Torunski, H. & Kuhn, G. (1981). High-energy pneumatic vibration corer for subaqueous sediments. *Senckenbergiana marit. 13*, 179-191. [Diameter 9 cm] R, MC, Mar

Murray, D.A. (1976). A light-weight corer for sampling soft subaqueous deposits. *Limnol. Oceanogr. 21*, 341-344. [Light-weight piston corer, diameter 3.5 cm, used cord rubber to propel a core tube into the sediments] R, M, FW

Raisanen, P., Timola, O. & Valtonen, T. (1981). A new corer for sampling sand and moraine bottom meiofauna. *Annls zool. fenn. 18*, 133-137. ['Perämeri' gravity corer; diameter 4.7 cm, weight 42 kg, with upper and lower closing valves] R, MC, Mar

Rueda, R.L. & Sanson, G.G. (1978)(1979). Estudio comparativo de dos metodes de muestreo del micro y mesobenthos con una descripcion de un nuevo modelo de tubo muestreador. (Comparative study of two methods of sampling of microbenthos and mesobenthos with description of a new model of sampling tube) (In Spanish). *Ciencias Ser. 8 Investnes mar. (Habana)*, No. 40, 31-48. [Diameter 3.6 cm] R, M, Mar

Ryan, P. (1970). Design and operation of an *in situ* frozen core gravel sampler. *Tech. Rep. Dep. Fish. Forest., Vancouver*, No. 12. [Manual corer using 'dry ice' dissolved in acetone as a freezing mixture] S, MC, FW

5.3. LARGE DIAMETER CORERS
[Diameter greater than 10 cm]

Carling, P.A. (1981). Freeze-sampling coarse river gravels. *Tech. Bull. Br. Geomorphol. Res. Gp*, *29*, 19-29. [2.2 cm diameter manual corer with CO_2 as freezing agent; takes external sample with diameter of 14-27 cm] S, MC, FW

Carling, P.A. & Reader, N.A. (1981). A freeze-sampling technique suitable for coarse river bed-material. *Sedim. Geol. 29*, 233-239. [See Carling 1981 for description] S, MC, FW

Grussendorf, M.J. (1981). A flushing-coring device for collecting deep-burrowing infaunal bivalves in intertidal sand. *Fishery Bull., Seattle*, *79*, 383-385. [Modification of sampler of Arkel & Mulder (1975)] R, MC, Mar

Mulder, M. & Arkel, M.A. van (1980). An improved system for quantitative sampling of benthos in shallow water using the flushing technique. *Neth. J. Sea Res. 14*, 119-122. [Modification of sampler of Arkel & Mulder (1975); easier to penetrate and remove from the substratum] R, MC, Mar

Rofes, G. & Savary, M. (1981). Description d'un nouveau modèle de carottier pour sediments fins. (Description of a new corer for fine sediments) (In French). *Bull. fr. Piscic.* No. 283, 102-113. [Manual and gravity corers with square cross-section, sampling area 121 cm^2, and closing shutter across mouth] R, M, FW

Vrišer, B. (1979). Metoda kombiniranega vzorčevanja bentoške in nektonske frankcije makrofavne na muljevitem dnu. (Method of combined sampling of benthic and nectonic fraction of macrofauna on muddy bottoms). (In Serbo-Croat). *Biol. Vest. 27*, 87-89. [Diameter 18 cm; lower half of sampler is a manual corer with rotating flat bars to retain core; upper half of sampler used to sample necton] S, M, FW

Williams, J.D.H. & Pashley, A.E. (1979). Lightweight corer designed for sampling very soft sediments. *J. Fish. Res. Bd Can. 36*, 241-246. [Diameter 10.1 cm; piston corer with sphincter valve for core retention] R, M, FW

5.4. MULTIPLE TUBE CORERS
[Weighted frames holding more than one core barrel]

Bakanov, A.I. (1979). New bottom grab designs and assessment of the aggregation state of the benthos. *Hydrobiol. J. 15*, 3, 77-82. R, M, FW

Maitland, P.S. & Morris, K.H. (1978). A multi-purpose modular limnological sampler. *Hydrobiologia*, *59*, 187-195. [Six corers, each of diameter 4.2 cm; gravity corer, messenger operated] R, M, FW

5.5. DIVER-OPERATED CORERS

Anima, R.J. (1981). A diver operated reverse corer to collect samples of unconsolidated coarse sand. *J. sedim. Petrol. 51*, 653-654. [Manual transparent plastic corer; diameter 8 cm, length 30 cm. Used on a sloping substrate to collect the top 5 cm of undisturbed sediment] D, M, Mar

Gale, W.F. (1981). A floatable, benthic corer for use with SCUBA. *Hydrobiologia*, *77*, 273-275. [Diameter 9 cm; manual corer with detachable drive handles. Core contents can be removed under water using compressed air; thus replicate samples can be taken without the diver surfacing] D, MC, FW

Martin, E.A. & Miller, R.J. (1982). A simple, diver-operated coring device for collecting undisturbed shallow cores. *J. sedim. Petrol. 52*, 641-642. [Manual corer; diameter 10 cm] D, M, FW/Mar

6. *SUCTION AND AIR-LIFT SAMPLERS*

6.1. MUD SUCKERS

[Samplers that suck in sediment by vacuum or by pressure difference between air within the sampler and the surrounding water; all these samplers take a very small sample]

Herrig, H. (1975). Der Bodensauger - ein neuartiges Gerät zur Entnahme von Sohlenproben aus großen Fließgewässern. (The slurp gun: a novel device for river bottom sampling) (In German). *Dt. gewässerk. Mitt. 19*, 104-107. [Automatic vacuum sucker, weight 8 kg and 135 kg with weighted stabilizing frame, used in large rivers] R, MC, FW

6.2. HYDRAULIC SUCTION SAMPLERS

[Samplers that use pumped water, often through a venturi tube, to suck sample up a tube]

Roy, D. (1978)(1979). Echantillonneur benthique d'eaux courantes peu profondes utilisant une pompe hydraulique à moteur. (The use of a hydraulic pump for sampling the benthos of shallow flowing water) (In French). *Annls Limnol. 14*, 289-294. [Suction pipe used to remove invertebrates within aluminium quadrat frame; pump with motor weighs 7.5 kg] R, MC, FW

6.3. AIR-LIFT SAMPLERS

[Samplers that use air under pressure to lift substratum and animals from the bottom and into a collecting net]

Enami, S., Onimaru, H. & Nakano, T. (1977). Studies on the air-lift larva pump. I. Preliminary examination on the practical method. (In Japanese) *Mem. Fac. Fish. Kagoshima Univ. 26*, 7-14. [Used for continuous sampling of fish larvae; can be side or stern mounted onto a boat] R, Mar

Norris, R.H. (1980). An appraisal of an air-lift sampler for sampling stream macroinvertebrates. *Bull. Aust. Soc. Limnol. 7*, 9-15. [Modified version of sampler of Pearson et al. (1973), chiefly by addition of a domed plastic cover which prevents loss of air from around the edge of the sampler] R, MC, FW

Verollet, G. & Tachet, H. (1978). Un échantillonneur à succion pour le prélèvement du zoobenthos fluvial. (A suction sampler for sampling benthic macroinvertebrates in large rivers) (In French). *Arch. Hydrobiol. 84*, 55-64. [A series of air jets open into a circular head with a sampling area of 0.1 m²; sample sucked up flexible tube of 4.2 cm internal diameter; used in water depths of 3 - 6 m] R, MC, FW

6.4. DIVER OPERATED HAND SUCKERS

[Suction samplers with a small mouth; they can be used to remove animals from a defined area of bottom, but latter must be disturbed by hand if invertebrates are not on the surface of the substratum]

Wilcox, J.R., Meek, R.P. & Mook, D. (1974). A pneumatically operated slurp gun. *Limnol. Oceanogr. 19*, 354-5. [Uses pneumatic piston and compressed air in retraction of plunger; sucks in epibenthic and pelagic organisms] D, MCLP, Mar

6.5. DIVER OPERATED HYDRAULIC SUCTION SAMPLERS

[Samplers that use pumped water, often through a venturi tube, to suck sample up a tube]

Brook, I.M. (1979). A portable suction dredge for quantitative sampling in difficult substrates. *Estuaries, 2*, 54-58. [Describes light-weight suction dredge based on Venturi principle; diver operated in water deeper than 1.5 m] SD, MCP, Mar

7. *ELECTROSHOCKING SAMPLERS*

Gerdeaux, D. & Jestin, J.-M. (1979). Exemple d'application du chalut électrifié dans un milieu tempéré très minéralisé. (An example of the application of an electrified trawl in a very mineralised temperate environment). (In French). *Annls Limnol. 14*, 281-287. [Small trawl with mouth 80 cm wide is used to sample crayfish and fish; electrification improves efficiency] R, MC, FW

Phillips, B.F. & Scolaro, A.B. (1980). An electrofishing apparatus for sampling sublittoral benthic marine habitats. *J. exp. mar. Biol. Ecol. 47*, 69-75. [Circular array of free-standing electrodes or grid electrodes used depending on habitat; stunned animals can be collected by a diver] R, MCP, Mar

Saila, S.B. & Williams, C.E. (1972). An electric trawl system for lobsters. *J. mar. Technol. Soc. 6*, 25-31. R, MC, Mar

Stewart, P.A.M. (1974). Norway lobster fishing with an electrified trawl. *Scott. Fish. Bull. 41*, 35-37. R, MC, Mar

8. *EFFICIENCIES AND COMPARISONS*

Andersin, A.-B. & Sandler, H. (1981). Comparison of the sampling efficiency of two van Veen grabs. *Finn. mar. Res.* No. 248, 137-142. [Efficiency of grab with large mesh 'windows' on upper surface was *c.* 50% higher than that of grab with small 'windows'] Mar

Andre, P., Legendre, P. & Harper, P.P. (1981). La sélectivité de trois engins d'échantillonnage du benthos lacustre. (The selectivity of three samplers for lake benthos) (In French). *Annls Limnol. 17*, 25-40. [Compares a Ponar grab and two basket-type artificial substrate samplers. All were selective] FW

Ankar, S. (1976). Final report from the Benthic Macrofauna Group. Baltic Sea Expert Meeting on Intercalibration of Biological and Chemical Methods. Askö, June 8-15, 1974. *Contr. Askö Lab. Univ. Stockholm*, No. 12, 27 pp. [Compares two versions (Finnish and Swedish) of the 0.1 m² van Veen grab, each with a different mesh 'window' on the upper surface of the grab. Swedish grab with larger mesh 'window' caught more animals] Mar

Ankar, S. (1977). Digging profile and penetration of the van Veen grab in different sediment types. *Contr. Askö Lab. Univ. Stockholm*, No. 16, 22 pp. [Digging profiles and volume of sediment taken by weighted (45 kg) and unweighted (25 kg) versions of the van Veen grab were compared on five different substrata. Penetration of the weighted grab doubled in sandy sediments] Mar

Ankar, S., Cederwall, H., Lagzdins, G. & Norling, L. (1978). Comparison between Soviet and Swedish methods of sampling and treating soft bottom macrofauna. Final report from the Soviet - Swedish Expert Meeting on Intercalibration of Biological Methods and Analyses Askö, July 5-12, 1975. *Contr. Askö Lab. Univ. Stockholm*, No. 23, 38 pp. [Soviet "Okean" grab (sampling area 0.08 m², weight 40 kg) and the Swedish van Veen grab (sampling area 0.1 m², weight 25 kg) were compared on mud bottom. The van Veen grab was more efficient. Soviet and Swedish benthic sieving methods were found to be equally efficient] Mar

Bakanov, A.I. (1979). New bottom grab designs and assessment of the aggregation state of the benthos. *Hydrobiol. J. 15*, 3, 77-82. [Modified Ekman grab and multiple corer used to study distribution patterns of some common benthic organisms in deep water] FW

Beltman, B. & Rietveld, W. (1981). Sampling macrofauna in ditches. *Hydrobiol. Bull. 15*, 153-159. [Compares vegetation samples with those taken with pond net and bottomless cage] FW

Bhaud, M. & Duchene, J.C. (1977). Observations sur l'efficacité comparée de deux bennes. (Observations on the comparative efficiency of two grabs) (In French). *Vie Milieu, 27A*, 35-53.

Ceccherelli, V.U. & Fabbri, G.G. (1978). Sampling efficiency of three different types of corers on meiofauna of muddy bottom. *Archo Oceanogr. Limnol. 19*, 85-98. [Compares multiple corer, diameter of each tube 1.5 cm, and single corers with diameters of 6 cm and 10 cm respectively] Mar

Christie, N.D. (1976). The efficiency and effectiveness of a diver-operated suction sampler on a homogeneous macrofauna. *Estuar. coast. mar. Sci. 4*, 687-693. [Estimates efficiency of suction sampler of Christie & Allen (1972)] Mar

Dickie, L.M. (1955). Fluctuations in abundance of the giant scallop, *Placopecten magellanicus* (Gmelin), in the Digby area of the Bay of Fundy. *J. Fish. Res. Bd Can. 12*, 797-857. [Estimated efficiency of commercial scallop dredges; efficiency 5 - 12%] Mar

Drake, C.M. & Elliott, J.M. (1982). A comparative study of three air-lift samplers for sampling benthic macro-invertebrates in rivers. *Freshwat. Biol. 12*, 511-533. [Compares three air-lift samplers; Mackey (1972), Pearson et al. (1973) and Verollet & Tachet (1978), and a Ponar grab and Naturalist's dredge in field and laboratory trials. Summarises evaluation of seven grabs, four dredges and three air-lift samplers] FW

Elliott, J.M. & Drake, C.M. (1981a). A comparative study of seven grabs used for sampling benthic macroinvertebrates in rivers. *Freshwat. Biol. 11*, 99-120. [Compares seven manually operated grabs of weight < 25 kg on four different types of substrata in the field and laboratory] FW

Elliott, J.M. & Drake, C.M. (1981b). A comparative study of four dredges used for sampling benthic macroinvertebrates in rivers. *Freshwat. Biol. 11*, 245-261. [Compares Irish Triangular dredge, a small Fast dredge and a medium sized and large Naturalist's dredge at three different sites] FW

Ellis, D.V. & Jones, A.A. (1980). The Ponar grab as a marine pollution monitoring sampler. *Can. Res.* June/July, 23-25. [Ponar grab (sampling area 0.052 m²) compared with the van Veen grab (sampling area 0.1 m²) and collected a significantly higher number and biomass of organisms but not significantly more taxa] Mar

Elmgren, R. (1973). Methods of sampling sublittoral soft bottom meiofauna. *Oikos*, Suppl. *15*, 112-120. [Six samplers for the meiofauna in the Baltic were compared: two grabs, three manual corers and a diver-operated corer. The grab-type box sampler (see Jonasson & Olausson 1966) and the diver-operated corer were found to be the only quantitative samplers] Mar

Exner, K.K. & Davies, R.W. (1979). Comments on the use of a standpipe corer in fluvial gravels. *Freshwat. Biol. 9*, 77-78. [Criticizes the 'standpipe' corer of Williams & Hynes (1974)] FW

Furse, M.T., Wright, J.F., Armitage, P.D. & Moss, D. (1981). An appraisal of pond-net samples for biological monitoring of lotic macro-invertebrates. *Wat. Res. 15*, 679-689. [Despite operator differences the 3-min pond-net sample was found to be a suitable technique for a river classification scheme based on the abundance of taxa and species] FW

Heip, C., Willems, K.A. & Goossens, A. (1977). Vertical distribution of meiofauna and the efficiency of the van Veen grab on sandy bottoms in Lake Grevelingen (The Netherlands). *Hydrobiol. Bull. 11*, 35-45. [Compared van Veen grab with samples taken by a diver in sandy sediments] Mar

Hongve, D. & Erlandsen, A.H. (1979). Shortening of surface sediment cores during sampling. *Hydrobiologia, 65*, 283-287. [Describes the compression of core samples of lake sediment taken with open-barrel gravity corers; contributory factors are diameter of corer and velocity of penetration. Implications in data interpretation are discussed] FW

Hornig, C.E. & Pollard, J.E. (1978). Macroinvertebrate sampling techniques for streams in semi-arid regions. Comparison of the Surber method and a unit-effort travelling kick method. *Environmental Monitoring Series. U.S. Environmental Protection Agency.* 600/4-78-040. [Compares Surber sampler with triangular pond net] FW

Hughes, B.D. (1978). The influence of factors other than pollution on the value of Shannon's Diversity Index for benthic macro-invertebrates in streams. *Wat. Res. 12*, 359-364. [Different sampling methods (see Hughes 1975), area sampled, time of year and level of identification all affected the value of the diversity index but depth and duration of sampling had no apparent effect] FW

Hummon, W.D. (1981). Extraction by sieving: a biased procedure in studies of stream meiobenthos. *Trans. Am. microsc. Soc. 100*, 278-284. [Examines effects of different sieve sizes on catches] FW

Jacobi, G.Z. (1978). An inexpensive circular sampler for collecting benthic macroinvertebrates in streams. *Arch. Hydrobiol. 83*, 126-131. [Compares own cylindrical sampler with Surber sampler] FW

Jensen, K. (1981). Comparison of two bottom samplers for benthos monitoring. *Envir. Technol. Lett. 2*, 81-84. [Van Veen grab (sampling area 0.1 m²) compared with large (sampling area 0.014 m²) and small (sampling area 0.0026 m²) HAPS corer (see Kanneworff & Nicolaisen 1973). Large HAPS corer gave better results in terms of abundance and diversity, and took less laboratory processing time than van Veen] Mar

Lewis, F.G. & Stoner, A.W. (1981). An examination of methods for sampling macrobenthos in seagrass meadows. *Bull. mar. Sci. 31*, 116-124. [Three PVC manual corers (5.5, 7.6 and 10.5 cm diameter) compared for efficiency in collecting macrobenthos amongst plants. Small corer collected greater numbers of some species. Two sieves of mesh 0.5 mm and 1 mm also compared and significant numbers of individuals were lost using the 1-mm mesh] Mar

Mackie, G.L. & Bailey, R.C. (1981). An inexpensive stream bottom sampler. *J. Freshwat. Ecol. 1*, 61-69. [See section 2.1 a): compared with a Surber sampler and found to be more efficient in terms of sampling effort and sorting time] FW

Mason, J., Chapman, C.J. & Kinnear, J.A.M. (1979). Population abundance and dredge efficiency studies on the scallop, *Pecten maximus* (L.). *Rapp. P.-v. Réun. Cons. perm. int. Explor. Mer, 175*, 91-96. [Estimates efficiencies of commercial scallop dredges; efficiencies about 20%] Mar

Massé, H., Plante, R. & Reys, J.-P. (1977). Étude comparative de l'efficacité de deux bennes et d'une succeuse en fonction de la nature du fond. (Comparative study of the efficiency of two types of spring-loaded grab and an air-lift suction sampler) (In French). In *Biology of benthic organisms*. (ed. B.F. Keegan et al.). Oxford. Pergamon. 433-441. [Compares Smith-McIntyre and Briba-Reys grabs with air-lift suction sampler] Mar

Nero, R.W. & Davies, I.J. (1982). Comparison of two sampling methods for estimating the abundance and distribution of *Mysis relicta*. *Can. J. Fish. aquat. Sci. 39*, 349-355. [Compares catches with vertical tow nets and quadrat sampling by SCUBA diver] FW

Norris, R.H. (1980). An appraisal of an air-lift sampler for sampling stream macroinvertebrates. *Bull. Aust. Soc. Limnol. 7*, 9-15. [See section 6.3.: modified air-lift sampler compared with Surber sampler; number of species and taxa caught were similar but air-lift samples more rapidly collected and sorted] FW

Pollard, J.E. (1981). Investigator differences associated with a kicking method for sampling macroinvertebrates. *J. Freshwat. Ecol. 1*, 215-224. FW

Rabeni, C.F. & Gibbs, K.E. (1978). Comparison of two methods used by divers for sampling benthic invertebrates in deep rivers. *J. Fish. Res. Bd Can. 35*, 332-336. [Compares diver operated version of sampler of Hess (1941) with rock-filled basket samplers] FW

Raisanen, P., Timola, O. & Valtonen, T. (1981). A new corer for sampling sand and moraine bottom meiofauna. *Annls zool. fenn. 18*, 133-137. [See section 5.2: compares "Perämeri" corer with manual corer used by SCUBA diver; no significant difference between total numbers of animals caught] Mar

Rodhouse, P.G. (1976). Survey of an oyster fishery with a hydraulic dredge calibrated by divers. *J. molluse. Stud. 42*, 455. [Compares hydraulic dredge with samples taken by diver; efficiency of dredge 10%] Mar

Rueda, R.L. & Sanson, G.G. (1978)(1979). Estudio comparativo de dos metodes de muestreo del micro y mesobenthos con una descripcion de un neuveo model de tubo muestraedor. (Comarative study of two methods of sampling of microbenthos and mesobenthos with description of a new model of sampling tube) (In Spanish). *Ciencias Ser. 8 Investnes mar. (Habana)*, No. 40, 31-48. [See section 5.2.: compares new corer with sampler of Bacescu 1957] Mar

Särkkä, J. (1975). The numbers of *Tubifex tubifex* and its cocoons in relation to the mesh size. *Biol. Res. Rep. Univ. Jyväskylä, 1*, 9-13. [Examines effects of different mesh sizes (range 0.27 - 0.82 mm) on estimates of numbers of *T. tubifex* and its cocoons] FW

Sarvala, J. & Ranta, E. (1977). Performance of the Muus sampler in surveys of the brackish-water macrofauna. *Annls zool. fenn. 14*, 191-197. [Compares dredge of Muus (1964) with cores taken by a diver] Mar

Shelbourne, J.E. (1957). The 1951 oyster stock in the rivers Crouch and Roach, Essex. *Fishery Invest., Lond.* Ser II, *21*, No. 2, 27 pp. [Estimated efficiency of a winch-operated oyster dredge; efficiency 31%. Own dredge compared with Petersen grab and efficiency of dredge was about 60%] Mar

Slack, K.V., Nauman, J.W. & Tilley, L.J. (1976). Evaluation of three collecting methods for a reconnaissance of stream benthic invertebrates. *J. Res. U.S. geol. Surv. 4*, 491-495. [Compares samples taken with a dip net, drift net and a 10-rock collection] FW

Takahashi, R.M., Miura, T. & Wilder, W.H. (1982). A comparison between the area sampler and the two other sampling devices for aquatic fauna in rice fields. *Mosquito News, 42*, 211-216. [Compares samples taken with a quadrat sampler, dip net and minnow trap] FW

Tyler, P. & Shackley, S.E. (1978). Comparative efficiency of the Day and Smith-McIntyre grabs. *Estuar. coast. mar. Sci. 6*, 439-445. [Compares grab of Day (1978) (see section 4.6) and grab of Smith-McIntyre (1954), both sampling areas 0.1 m^2; sampling efficiency very similar but Day grab caught more deeper-burrowing species in hard sand] Mar

Walne, P.R. (1956). The biology and distribution of the slipper limpet *(Crepidula fornicata)* in Essex rivers. *Fishery Invest., Lond.* Ser. II, *20*, No. 6. 50 pp. [Compares commercial oyster dredge with Petersen grab; efficiency of dredge was about 16%] Mar

Whiteside, M.C. & Lindegaard, C. (1980). Complementary procedures for sampling small benthic invertebrates. *Oikos, 35*, 317-320. [Compares corer of Kajak (1965) and funnel trap which was more efficient at collecting early instars of insects] FW

Wielgosz, S. (1978). Evaluation of the reliability of benthopotamous samples. *Bull. Acad. pol. Sci., Sèr. Sci. biol. 26*, 447-451. [Compares small grab of Szczepański (1953) with Birge-Mkman grab for sampling oligochaetes in a river] FW

Wildish, D.J. (1978). Sublittoral macro-infaunal grab sampling reproducibility and cost. *Tech. Rep. Fish. mar. Serv. Can.* No. 770, 14 pp. [Compares Petersen and Smith-McIntyre grabs] Mar

Williams, D.D. (1981). Evaluation of a standpipe corer for sampling aquatic interstitial biotopes. *Hydrobiologia, 83*, 257-260. [Compares small standpipe corer of Williams & Hynes (1974) (sampling volume 25 cm^3) with a larger model (sampling volume 100 cm^3); there were significant differences between the two sizes of corer] FW

Williams, D.D. & Hynes, H.B.N. (1979). Reply to comments by Exner and Davies on the use of a standpipe corer. *Freshwat. Biol. 9*, 79-80. [Reply to criticisms of Exner & Davies (1979)] FW

Williams, J.D.H. & Pashley, A.E. (1979). Lightweight corer designed for sampling very soft sediments. *J. Fish. Res. Bd Can. 36*, 241-246. [Compares own corer with corers of Phleger (1951), Kemp et al. (1971) and those taken by diver] FW

Word, J.Q. (1975). A comparison of grab samplers. Coastal Water Research Project: Annual Report 1975, 63-65. [Briefly compares Spade box corer, orange-peel grab, Smith-McIntyre grab, van Veen grab, Shipek scoop and Ponar grab] Mar

9. *SAMPLERS FROM CATALOGUES*

Corers

Vibratory sediment corer (Hydraulics Research Station, Wallingford, Oxon. OX10 8BA): Equipment notes No. 9. [Three versions; core diameters and lengths: 5 cm and 0.8 m, 5 cm and 2.0 m, 12.7 cm and 0.4 m]

AUTHOR INDEX

By first author only. References are to *sections:* within each section references are arranged alphabetically by author.

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Williams, D.D. & Hynes 1979	8
Williams, J.D.H. & Pashley 1979	5.3, 8
Word, J.Q. 1975	8

LIST OF SUPPLIERS

The following may be able to supply some of the samplers listed in the bibliography of Elliott & Tullett (1978) and this supplement. The names of these suppliers are given for the convenience of readers of the bibliography and do not imply official recommendation of their products. Equipment of similar specifications by other manufacturers may be equally effective.

Hydro-Bios Apparatabau GmbH,
P.O. Box 8008,
2300 Kiel-Holtenau,
West Germany.

Hydro Products,
Box 2528, San Diego,
California 92112
U.S.A.

Their U.K. Agents are:
Techmation Ltd.,
58 Edgware Way,
Middlesex HA8 8JT

Kahlsico International Corp.,
P.O. Box 1166,
El Cajon,
California 92022
U.S.A.

Their U.K. Agents are:
Offshore Environmental Systems Ltd.,
17 West Street,
Farnham, Surrey GU9 7DR

Wildco Instruments,
301 Cass Street,
Saginaw, Michigan 48602,
U.S.A.

A limited range of pond nets and simpler equipment can be obtained from:

Antox (UK) Ltd.,
Swadlincote,
Derbyshire.

S.M. Davis,
25, Quest Hills Road,
Malvern, Worcs WR14 1RJ

T. Gerrard and Co.,
(Division of Griffin Biological Laboratories),
Gerrard House, Worthing Road,
E. Preston,
W. Sussex BN16 1AS

Naturalist's dredges and anchor dredges of various sizes and van Veen grab can be obtained from:

Marine Biological Association,
The Laboratory,
Citadel Hill,
Plymouth, PL1 2PB.

Corrections to bibliography of Elliott & Tullett (1978)

(Occasional Publication No. 4)

Page 6. Hellawell (1977) should be (1978).

Page 29. Kubinov to Kudinov.

Page 41. Pearson, Litterick & Jones (1973); initials of Jones should be N.V.

Page 46. Chutter & Noble (1966); pg. 59 should be 95.

Page 46. Emig & Lienhart (1971); "Princple" should be "Principle".

Page 52. Note that the Freshwater Biological Association can no longer supply a "Gilson corer / F.B.A. automatic mud sampler".

Note that the G.M. Mfg. Co. is no longer in New York and has been consolidated with Kahlsico (see list of suppliers).

Page 54. "Haywood" should be "Hayward".
Add "Muus dredge (Muus 1964) 3.3".

Page 57. Gale & Thompson (1975); 6.6 should be 6.5.