Reprinted from

Journal of the Fisheries Research Board of Canada

Réimpression du

Journal de l'office des recherches sur les pêcheries du Canada

Increased Invertebrate Drift in an Experimental Stream Caused by Electrofishing

PETER A. BISSON

Volume 33 • Number 8 • 1976

Pages 1806–1808

Environment Canada
Fisheries and Marine Service

Environnement Canada
Service des pêches et des sciences de la mer

Increased Invertebrate Drift in an Experimental Stream Caused by Electrofishing

PETER A. BISSON

Weyerhaeuser Company, Longview, Wash. 98632, USA

BISSON, P. A. 1976. Increased invertebrate drift in an experimental stream caused by electrofishing. J. Fish. Res. Board Can. 33: 1806–1808.

Electrofishing stimulated a tenfold increase in total macroinvertebrate drift in an experimental stream channel. While nearly all aquatic taxa exhibited elevated drift rates during shocking, turbellarians and chironomids showed the greatest total increases. A few taxa were relatively unaffected. Except for the Chironomidae, benthic invertebrate biomasses were not significantly depressed immediately following electrofishing.

BISSON, P. A. 1976. Increased invertebrate drift in an experimental stream caused by electrofishing. J. Fish. Res. Board Can. 33: 1806–1808.

La pêche à l'électricité augmente de 10 fois la dérive totale des macro-invertébrés dans le chenal d'un cours d'eau expérimental. Alors que presque tous les taxons aquatiques manifestent des taux de dérive plus élevés au moment du choc, les turbellariés et les chironomides sont les groupes chez lesquels les augmentations totales sont les plus fortes. Quelques taxons sont relativement inaffectés. A l'exception des Chironomidae, la biomasse des invertébrés benthiques ne diminue pas de façon significative immédiatement après la pêche à l'électricité.

Received March 18, 1976
Accepted May 12, 1976

Reçu le 18 mars 1976
Accepté le 12 mai 1976

ELECTROFISHING is usually the method of choice when collecting live fish in woodland streams possessing considerable cover. But despite its widespread use, relatively little is known of the effect of electrofishing on benthic macroinvertebrate populations. This paper describes the results of a brief experiment designed to detect immediate changes in the drift of stream invertebrates in response to rather intense shocking.

Electrical stimuli have been used by some workers for collecting and sorting purposes (Bay-

Printed in Canada (J4253)
Imprimé au Canada (J4253)

TABLE 1. Invertebrate drift (micrograms per meter^3) in the shocked and unshocked riffles. Pretreatment values are means of hourly samples taken from 0800 to 1100. Posttreatment values are means of samples taken from 1300 to 1500. Treatment values refer to the 1200 sample.

	Pretreatment		Treatment		Posttreatment	
Taxon	Shocked	Unshocked	Shocked	Unshocked	Shocked	Unshocked
Turbellaria	196	12	51120	67	646	10
Oligochaeta	278	99	1829	159	124	177
Planorbidae	244	47	1238	75	97	250
Hydracarina	55	20	32	28	22	40
Ostracoda	1194	247	1723	159	475	242
Copepoda	19	13	596	10	12	8
Collembola	3634	1049	2961	1675	3620	696
Ephemeroptera	1	4	2170	4	82	17
Plecoptera	115	70	3160	36	248	87
Trichoptera	12	6	1268	2	121	9
Chironomidae	3544	1702	19654	2016	1747	1419
Other Diptera	128	80	133	44	30	12
Misc. Aquatic	110	83	60	32	29	52
Terrestrial	28	19	79	74	20	16
Totals	9558	3451	86023	4381	7273	3035

less 1961; Ervin and Ball 1974) or for parasite control (Combs 1968), and their experiments have shown that various taxa may often react in a dissimilar manner. A corollary purpose of the study was therefore to compare the responses of different invertebrates to electrofishing and to discuss the implications of differing responses to stream sampling procedures.

Materials and methods — The experiment was carried out at the Kalama Springs Laboratory in southwestern Washington. Characteristics of the experimental stream used in the study have been described by Thut (1969). Two riffles, an upstream control and downstream treatment, were selected for comparison. The riffles were similar in size (18.6 m^2), substrate composition (mostly pebbles and cobbles), and flow (1.5 m^3/min). The only difference was that average velocity in the treatment riffle was 53 cm/s while in the control the average velocity was 43 cm/s.

Driftnets made of 210-μm mesh nylon spanned the width of the streams so that the entire flow passed through them. Nets were positioned at the upstream and downstreams ends of each of the two riffles. The upstream nets filtered out incoming drift, while the downstream nets captured only material that originated from the test riffles. Samples were taken for 15-min periods at hourly intervals commencing at 0800 and terminating at 1500 on November 5, 1975. During the 1200 sample, the treatment riffle was exposed to electrofishing for 4.5 min, or about 15 s/m^2 of riffle surface area.

A portable battery-powered pulsed DC shocker (Smith-Root Type VII electrofisher) administered 500 V shocks, each of 8 ms duration and pulsed at a frequency of 80 Hz. The low conductivity in the experimental stream (50 μmho/cm) made it necessary to use the high voltage setting to stun fish sufficiently for them to be netted. During shocking the electrodes were carefully passed over the substrate so that no mechanical disruption to invertebrates or periphyton occurred. At no time was the stream waded. Identical procedures were followed in the upstream control riffle during the 1200 sample, except that the shocker was turned off.

Drift samples were sorted under magnification and dry biomasses were determined gravimetrically. Results are expressed as micrograms of invertebrate dry weight per meter^3 of water that passed the downstream end of the riffles.

Results — The drift of nearly all groups of invertebrates increased during electrofishing (Table 1); total drift biomass in the shocked riffle was about tenfold greater than the means of pretreatment and posttreatment samples. Total biomass in the control sample at 1200 did not differ greatly from morning or afternoon averages. Even excluding the noon measurement period, the treatment riffle produced significantly more drift ($P < 0.01$, paired t-test) than the control. However, the absence of a great increase in invertebrate drift in the 1200 control sample suggests that the large numbers of invertebrates drifting in the treatment riffle at 1200 were caused by electrofishing.

Responses of various taxa to shocking differed greatly. Collembola and Hydracarina were apparently unaffected. Turbellaria showed the greatest increase, rising from 2% of the drift (by weight) before shocking to nearly 60% of the drift from the treatment riffle during shocking.

Chironomidae also exhibited especially high drift rates during shocking. A few groups (Turbellaria, Ephemeroptera, Plecoptera, Trichoptera) maintained higher drift rates throughout the 3 h following electrofishing than had been measured in morning samples. Some others showed slight declines, although similar declines were often observed in the control riffle.

Condition of the shocked invertebrates was checked visually before they were preserved. It seemed that most organisms had been stunned and carried downstream into the net before reviving; few individuals had been killed.

Four 0.017 m^2 core samples were taken from both treatment and control riffles on the day before and the day after the electrofishing experiment to determine if shocking had any short-term effect on benthic invertebrate biomasses. T-tests indicated that no significant differences in the biomasses of various taxa had occurred in the control riffle after the experiment. In the treatment riffle only Chironomidae exhibited a significant change ($P < 0.05$), decreasing from 8.0 g/m^2 before shocking to 3.9 g/m^2 after shocking. Other taxa, including Turbellaria, showed no significant declines.

Discussion — Dissimilar responses of aquatic macroinvertebrates to shocking suggest that electrical devices for attraction and sorting may be effective with some taxa and relatively ineffective with others. It is unlikely that electrofishing can be used to give quantitative estimates of total benthic biomass.

Whether or not repeated electrofishing over the same area of a stream can significantly reduce standing stocks or alter invertebrate community structure remains to be shown. The observed decline in chironomid biomass, although statistically significant, may not have been due exclusively to the experimental treatment; even the high drift rate during shocking accounted for less than 1% of the estimated benthic biomass. Other factors requiring consideration in assessing the impact of electrofishing on invertebrate populations include knowledge of recolonization rates from upstream sources and the extent of physical disturbance to the stream substrate.

Fish collected by electrofishing are sometimes held for stomach analysis. When sampling proceeds in a downstream direction, large numbers of invertebrates dislodged by shocking drift downstream and may be consumed by fish before the fish themselves are captured. Because aquatic invertebrates are not uniformly affected by electrofishing, stomach samples taken from such fish will not represent typical food organisms. While Vincent's (1971) review of electrofishing procedures does not specify whether collecting should be done in an upstream or downstream direction, upstream collections would appear to be preferable when fish are to be retained for studies of food habits.

Acknowledgments — I thank R. Palmason, V. Era, C. Backman, and G. Gilbert for technical assistance and M. L. Bothwell, R. B. Herrmann, and R. N. Thut for reviewing the manuscript.

Addendum — Two papers (Elliot, J. M. and T. B. Bagenal. 1972. The effects of electro-fishing on the invertebrates of a Lake District stream. Oecologia [Berlin] 9: 1–11.; Fowles, C. R. 1975. Effects of electric fishing on the invertebrate fauna of a New Zealand stream. N.Z. J. Mar. Freshwater Res. 9: 35–44.), obtained too late for inclusion, both recorded large increases in drift during electrofishing. In addition, Elliot and Bagenal (1972) noted a 30% decline in benthic invertebrate numbers after electrofishing, compared to an 8% decrease found by Fowles (1975).

BAYLESS, J. D. 1961. The use of electrical stimuli in live-picking organisms from bottom samples, p. 286–288. *In* Proc. 15th Annu. Conf., Southeast. Assoc. Game and Fish Comm.

COMBS, B. D. 1968. An electrical grid for controlling trematode cercariae in hatchery water supplies. Prog. Fish Cult. 30: 67–75.

ERVIN, J. L., AND R. C. BALL. 1974. Electronic devices for the capture of aquatic invertebrates. Inst. Water Res., Michigan State Univ., Tech. Rep. 40: 71 p.

THUT, R. N. 1969. Feeding habits of larvae of seven *Rhyacophila* (Trichoptera: Rhyacophilidae) species with notes on other life-history features. Ann. Entomol. Soc. Am. 62: 894–898.

VINCENT, R. 1971. River electrofishing and fish population estimates. Prog. Fish Cult. 33: 163–169.