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IN SITU BIOASSAY OF INVERTEBRATES ON WATER QUALITY OF
COEUR D'ALENE RIVER BASIN - PILOT STUDY

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by

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INTRODUCTION

The following research was funded, in part, by the Coeur d'Alene District Bureau of Land Management under contract #ID060-PH9-0166. The project was developed and conducted by Dr. Fred Rabe and Russell Biggam through the Idaho Water Resources Research Institute, University of Idaho, Moscow, Idaho.

The Coeur d'Alene river, impacted by heavy metal contamination from mining wastes since the late 1800s, continues to concern agency and private citizens in northern Idaho. This research was designed to test the feasibility of biological monitoring methods for the river system. It is hoped that eventually biological methods such as this can be used to periodically evaluate recovery and overall health of this important ecosystem.

IN SITU BIOASSAY OF INVERTEBRATES ON WATER QUALITY OF COEUR D'ALENE RIVER BASIN - PILOT STUDY

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Monitoring aquatic invertebrates in the Coeur d'Alene River will help identify changes in heavy metal concentrations in the drainage due to leakage of tailing ponds in the upper stretch of the river (Hornig, EPA, personal communication). Other concerns are the removal of tailings at the superfund site on water quality further downstream and the consequences of opening up for operation the Sunshine Mine.

Macroinvertebrates are important organisms for detecting alterations of the environment. Since they live in the water for at least a two month period, their presence or absence indicates environmental conditions during the recent past. Chemical or microbial tests of the water only detect present conditions which could change the next minute. Also, macroinvertebrates move around very little so they reflect conditions in the immediate vicinity of the sampling site.

The objective of this experiment was to bioassay insects in the Coeur d'Alene River using a piece of equipment developed by R. C. Biggam and M. A. Brusven. The question was whether this sampler would work in a large river as opposed to small streams where it was initially tested, and whether insects transferred from relatively clean water habitats would survive to any degree in waters contaminated with metals.

Methods

The experiment consisted of placing aquatic insects in plastic capsules covered with a fine-mesh screen. These capsules were supported by styrofoam plates which float in the water and are tied to a piece of rebar in the channel. A plastic cap prevents the immature stages from leaving the capsules as adults. Refer to Fig. 1.

One-inch (25 mm) heavy-duty styrofoam was cut into 12" x 8" (0.3 x 0.2 m) blocks and pointed for hydrodynamic floatation capabilities. Twelve 29 mm holes were drilled into the blocks, staggering sets of three to allow maximum flow around and through the individual cages. The cages were made of clear plastic snap-on medicine containers 80 x 28 mm. Two 10 mm holes were sanded into opposite sides of the containers to allow flow. These were then covered by lumite screen to contain the insects to be tested. The lumite was glued using chloroform to adhere the plastic to the screen (Figure 1).

Containers were then placed into the twelve holes. Parachute cord was passed through a hole in the front of the platforms and tied around a steel stake hammered into the substrate of the stream.

The floats were placed in runs where water movement is discernible but not excessive. Insect specimens used in the experiment were collected using a kick screen in the Coeur d'Alene River (North Fork) and the South Fork above Mullan, Idaho. Their selection was based on size and abundance of individuals observed in the samples. From the Upper South Fork,

Seratella tibialis McDunnough (Ephemeraptera) was placed in eight chambers, *Lara avara* LeConte (Coleoptera) in two chambers, and *Sortosa* sp. (Trichoptera) in two chambers. From the North Fork, *Timpanoga hecuba* Eaton (Ephemeroptera) were placed in six chambers and *Calineuria californica* Banks (Plecoptera) in six chambers.

Insects in the chambers at the four sites were then checked for mortalities at one, two, four, eight, and sixteen day intervals (Tables 2 and 3), and temperatures, conductivity, alkalinity, zinc, copper, cadmium, substrate size, depth, and embeddedness were recorded at each station (Table 1).

Results and Discussion

At the upper sites (Canyon Creek and South Fork above Wallace), Lara avara survived in the control site but had 50% mortality in Canyon Creek. Sortosa sp. was apparently too sensitive a test species, as all died at both sites. Ephemerella infrequens were observed in their last instance at 50% in the control (S. Fork) and 62⅓% in Canyon Creek emerged. Some of the deaths at both sites may have been the result of pre-emergence difficulties, thus this species showed little preference for the particular conditions at this station.

At the lower sites, N. Fork (control) and S. Fork, two Timpanoga hecuba died in the control and only one in the S. Fork test; however none emerged in the N. Fork whereas 3 (50%) emerged in the S. Fork.

This may have been a forced emergence by substances or conditions in the S. Fork as compared to the N. Fork since T. hecuba were probably attempting to escape from the cannisters. Calineuria californica is a very hardy species and no mortalities occurred in the control site, but one mortality was recorded in S. Fork (test site). Observational tests could only be made since there were so few replications.

In addressing the first question dealing with the experiment, it was observed that the sampler worked satisfactorily in a large river. The cannisters did not become dislodged from the floats even though the water level rose after a rain and there was more turbulence in the water. Also a minimum of vandalism occurred with only one sampler disappearing

towards the end of the study but later recovered. This was a site frequented by numerous people.

Secondly, survival of insects in waters containing relatively high concentrations of zinc was better than expected. In fact overall survival did not appreciably differ from the control areas with low concentrations of zinc (Table 1). Thus short-term exposure (16 days) of invertebrates in comparable sites in the Coeur d'Alene River varied little.

Recommendations

Time of monitoring next time should probably occur in August rather than September since smaller instars would probably not emerge then. This is especially true of S. tibialis.

Statistical tests involving confidence limits will require additional collecting sites and number of individuals comprising each species. The experiment reported on did not pretend to observe large numbers of individuals since the work was of a preliminary nature involving the feasibility of monitoring invertebrates in the Coeur d'Alene River.

Benthos Station 13 should be eliminated since the species composition was somewhat similar to Station 33 at the confluence. Station 13 is intermediate between Canyon Creek and the mouth of the South Fork (Station 33).

Monitoring should be linked with collecting benthos samples in the river, noting changes in the native fauna. An example was the Canyon Creek site which had low species richness compared to other areas tested.

Table 1 Selected Physical and Chemical Characteristics of Stations Sampled on the Coeur d'Alene River

Characteristics	Sta 28	Sta 5	Sta 6	Sta 13	Sta 33	Sta 34	Sta 9
Brief Description	S. Fork above Mullan	S. Fork 30 m above Wallace	Mouth of Canyon Creek	Smelterville Flats	Mouth of S. Fork	100 m above Mouth of N. Fork	500 m below confluence
Mean Depth (cm)	18	15	18	25	18	33	60
Substrate[1] Size	8	7	8	6	6	6	6
Surrounding[1] Material	5	5	6	4	4	5	2
Embeddedness[1] (%)	50	25	25	25	25	25	50
Temperature (° C.)	11	15	17	15	11	15	13
Conductivity (micromhos)	78	130	100	190	180	53	120
Alkalinity (mg/l)	40	48	34	38	30	24	26
Zinc (mg/l)	0.03	0.1	3.1	2.0	1.8	0.02	0.7
Copper (mg/l)	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01	>0.01
Cadmium (mg/l)	0.05	0.05	0.07	0.06	0.05	0.04	0.06

1. Brusven, M. A. and W. R. Meehan; Interacting Effects of Substrate and Fluctuating Flows on the Distribution and Abundance of Aquatic Insects. Project Completion Report No. 1702-13 USDA-USFS. September 1979.

Table 2 In Situ Bioassay of Two Insects Placed in the South Fork and the North Fork of the Coeur d'Alene River

	N. Fork Coeur d'Alene River #34					S. Fork Coeur d'Alene River #33				
Days	1	2	4	8	16	1	2	4	8	16
Date	8/26	8/27	8/29	9/2	9/9	8/26	8/27	8/29	9/2	9/9
1. Timpanoga hecuba	A	A	A	A	A	A	A	A	A	E
2. Timpanoga hecuba	A	A	A	D	-	A	A	A	A	E
3. Timpanoga hecuba	A	A	A	A	A	A	A	A	D	-
4. Timpanoga hecuba	A	A	A	A	A	A	A	A	E	-
5. Timpanoga hecuba	A	A	A	A	A	A	A	A	A	A
6. Timpanoga hecuba	A	A	A	D	-	A	A	A	A	A
7. Calineuria calif.	A	A	A	A	A	A	A	A	A	A
8. Calineuria calif.	A	A	A	A	A	A	A	A	A	A
9. Calineuria calif.	A	A	A	A	A	A	A	A	A	D
10. Calineuria calif.	A	A	A	A	A	A	A	A	A	A
11. Calineuria calif.	A	A	A	A	A	A	A	A	A	A
12. Calineuria calif.	A	A	A	A	A	A	A	A	A	A

D - Dead

A - Alive

E - Emerged

Table 3 In Situ Bioassay of Insects Placed in the South Fork of the Coeur d'Alene River and Canyon Creek

	S. Fork Coeur d'Alene Above Wallace #5					Canyon Creek #23				
Days	1	2	4	8	16	1	2	4	8	16
Date	8/26	8/27	8/29	9/2	9/9	8/26	8/27	8/29	9/2	9/9
1. Sortosa sp.	D	–	–	–	–	D	–	–	–	–
2. Sortosa sp.	D	–	–	–	–	A	A	D	–	–
3. Lara avara	A	A	A	A	A	A	A	A	A	A
4. Lara avara	A	A	A	A	A	A	A	A	D	–
5. Serratella tibialis	A	A	A	D	–	A	A	A	E	–
6. Serratella tibialis	A	A	A	A	D	A	A	A	A	D
7. Serratella tibialis	A	A	A	A	E	A	A	A	E	–
8. Serratella tibialis	A	A	A	D	–	A	A	A	A	E
9. Serratella tibialis	A	A	A	A	E	A	A	A	A	A
10. Serratella tibialis	A	A	A	A	E	A	A	A	D	–
11. Serratella tibialis	A	A	A	A	D	A	A	A	E	–
12. Serratella tibialis	A	A	A	A	E	A	A	A	E	–

D - Dead

A - Alive

E - Emerged

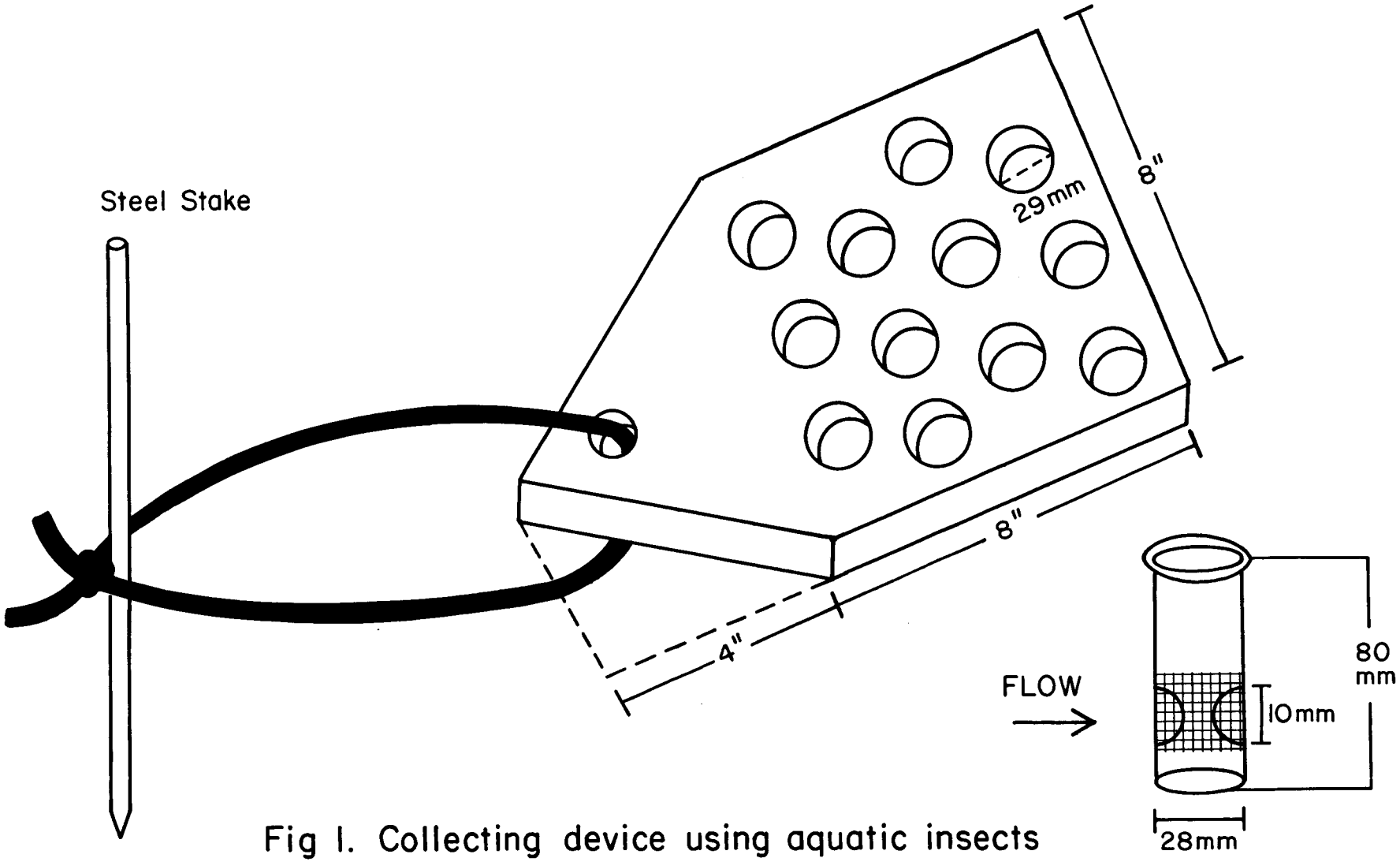

Fig I. Collecting device using aquatic insects for in situ bioassay experiment.

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