ASSESSMENT OF MACROINVERTEBRATE ABUNDANCE IN THREE LOWER SNAKE RIVER RESERVOIRS

By

David H. Bennett

Department of Fish and Wildlife Resources
College of Forestry, Wildlife and Range Sciences
University of Idaho
Moscow, 83844-1136

JANUARY 1995

INTRODUCTION

Macroinvertebrates are an important food item of juvenile downstream migrating spring and summer chinook salmon *Oncorhynchus tshawytscha* and steelhead trout *O. mykiss* (Bennett and Shrier 1986) and subyearling fall chinook salmon (Curet 1993). Sampling of benthic macroinvertebrates in Lower Granite Reservoir was conducted in 1985 (Bennett and Shrier 1986) and nearly annually since 1989 in the soft substrate (Bennett et al. 1991, 1993a, 1993b, 1994). In fall 1993, sampling of the hard substrate was initiated in Lower Granite Reservoir.

The benthic macroinvertebrate community in the soft substrate has changed little in the last few years. Oligochaetes and chironomids have dominated the soft substrate community in Lower Granite Reservoir since 1976 - 1977, shortly after impoundment (Dorband 1980). Dorband (1980) reported sampling 74 taxa although oligochaetes and chironomids comprised 90% of the organisms sampled from Lower Granite, Little Goose, and Ice Harbor reservoirs. Bennett et al. (1990, 1991, 1993, 1994) showed oligochaetes and chironomids comprised >90% of the benthic macroinvertebrate community in Lower Granite Reservoir. Although Dipterans are important in the diet of salmonids in the reservoir (Bennett and Shrier 1986; Curet 1993), numerous organisms found in the stomachs of these fishes are not found in soft substrata and originate most likely from hard substrata. The purpose of this study is to qualitatively and quantitatively assess the community along the hard substrata in Lower Granite, Little Goose and Lower Monumental reservoirs.

OBJECTIVES

1. To describe the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose and Lower Monumental reservoirs;
2. To obtain indices of abundance of the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose and Lower Monumental reservoirs; and
3. To assess seasonal indices of abundance of the benthic macroinvertebrate community of hard substrata in Lower Granite, Little Goose and Lower Monumental reservoirs.

METHODS

Hard Substrata

Use of barbecue baskets are a well-known method of artificial substrate sampling. These are useful for collecting data from habitats difficult to sample by other methods (Rosenberg and Resh 1982). Dorband (1980) used barbecue baskets to sample benthic invertebrates on hard substrata in Lower Granite Reservoir. The artificial substrate design used for this study follows that used by Benfield et al. (1974). Concrete cones will be used for artificial substrate to standardize the surface area available for colonization in each basket. The cones will be formed from 192.2 ml (6.5 oz.) Styrofoam cups filled with redimix concrete. Each cone possesses approximately 171.8 cm^2 (0.01718 m^2) of surface area. After hardening, they will be soaked for 3 days in 1% phosphoric acid to remove leachates, and then in water for 3 days to eliminate the acid.

The sampling units consist of wire barbecue baskets (Char-broil, Columbus, GA) measuring 25.4 cm x 16.5 cm (10 in. x 6.5 in.) filled with 10 concrete cones which are attached to concrete anchor-weights by green polypropylene rope. Artificial substrata exhibit less sampling variability and increased sampling precision compared with other sampling, thus, requiring fewer sample replicates (Rosenberg and Resh 1982). For this study two sets of three replicate baskets will be placed at each site, one shallow set extending 3 m (10 ft) from the anchor and one deep set extending 9 m (30 ft), giving a total of 18 baskets per reservoir. Three replicate baskets are used based on the literature; Mason et al. (1973) found that three replicate baskets can be expected to estimate the true mean number of organisms within 20% of the sample mean with 95% confidence.

The baskets will be removed every 8 weeks, resulting in six sampling periods in 1995 encompassing all four seasons. The 8-week exposure time was also derived from Mason et al. (1973) who found that samples exposed to this time generally contained more organisms than those exposed for less time. The advantage of the 8-week exposure was most evident during winter months, when organisms are fewer in number. Artificial substrate will be emptied from the baskets into plastic buckets, brushed clean of invertebrates and debris with a small, soft paintbrush, and returned to the baskets. The baskets will then be returned to the water for another 8 weeks. Contents of the buckets will be poured through a 0.595 mm sieve bucket (#30), preserved in 10% formalin with rose bengal dye (Mason and Yevich 1967) and taken to the laboratory for identification.

Species composition and structure, relative abundance, density, and standing crop will be quantified for 2 years for both shallow and deep waters. Sample numbers and weights will be expanded by 5.82 for density (no./ m^2) and standing crop (g/ m^2) estimates.

Rosenburg and Resh (1982) define the time necessary for the population, or measurement thereof, to reach a state of equilibrium as the "duration of exposure required to achieve optimal colonization." A standard exposure time of 8 weeks was chosen for basket samplers; however, it is not known if optimal colonization is reached before or after 8 weeks. To determine the optimal colonization time for barbecue basket samplers at different times of the year, a second set of baskets samplers will be used.

Basket sampler design is identical to that previously described. Three replicate baskets filled with 10 concrete cones will be extended from the rip-rip at sampling Site 3 (river mile 127.5, river km 204) with 10 ft (3 m) polypropylene rope to make up one sampling unit.

Seven units will be placed in the water on the same day. One unit will be removed after exposure for 1, 2, 4, 6, 8, 12, and 20 weeks. Sampling for a 20-week period will occur two times over the year's study. One will take place from late summer to winter, and one from winter to spring. Field processing of the samples and laboratory procedures will be similar to those described previously.

REFERENCES

Benfield, E.F., A.C. Hendricks, and J. Cairns, Jr. 1974. Proficiencies of two artificial substrata in collecting stream macroinvertebrates. Hydrobiologia 45(4): 431-440.

Bennett, D.H. and F.C. Shrier. 1986. Effects of sediment dredging and in-water disposal on fishes in Lower Granite Reservoir, Idaho-Washington. Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., L.K. Dunsmoor, and J.A. Chandler. 1988. Fish and benthic community abundance at proposed in-water disposal sites, Lower Granite Reservoir. Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., L.K. Dunsmoor, and J.A. Chandler. 1990. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-Year 1 (1988). Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., J.A. Chandler and G. Chandler. 1991. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-Year 2 (1989). Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., T. Dresser, K. Lepla, T. Curet, and M. Madsen. 1993a. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-Year 3 (1990). Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., T. Dresser, K. Lepla, T. Curet, and M. Madsen. 1993b. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-Year 4 (1991). Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Bennett, D.H., T. Dresser, K. Lepla, T. Curet, and M. Madsen. 1994. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-Year 5 (1992). Completion Report. U.S. Army Corps of Engineers, Walla Walla, WA.

Curet, T. 1993. Habitat use, food habits and the influence of predation on subyearling chinook salmon in Lower Granite and Little Goose reservoirs, Washington. Master's Thesis. University of Idaho, Moscow.

Dorband, W.R. 1980. Benthic macroinvertebrate communities in the Lower Snake River reservoir system. Doctoral Dissertation. University of Idaho, Moscow.

Mason, W.T., Jr., J.B. Anderson, R.D. Kries, and W.C. Johnson. 1970. Artificial substrate sampling macroinvertebrates in a polluted reach of the Klamath River, Oregon. Journal of the Water Pollution Control Federation. 42(8): R315-328.

Mason, W.T., Jr., J.B. Anderson, and G.E. Morrison. 1967. Limestone- filled, artificial substrate sampler-float unit for collecting macro-invertebrates in large streams. Progressive Fish-Culturist 29(2):74.

Mason, W.T., Jr., C.I. Weber, P.A. Lewis, and E.C. Julian. 1973. Factors affecting the performance of basket and multiplate macroinvertebrate samplers. Freshwater Biology 3: 409-436.

Mason, W.T., Jr. and P.P. Yevich. 1967. The use of phloxine B and rose bengal stains to facilitate sorting benthic samples. Transactions of the American Microscopic Society 86(2): 221-223.

Rosenberg, D.M. and V.H. Resh. 1982. The use of artificial substrates in the study of freshwater benthic macroinvertebrates. Pages 175-235 *in*: J. Cairns, Jr., editor. Artificial substrates. Ann Arbor Science, Ann Arbor, Michigan.

Proposed Budget

ASSESSMENT OF MACROINVERTEBRATE ABUNDANCE IN THREE LOWER SNAKE RIVER RESERVOIRS, WASHINGTON.

ITEM	COST
Salaries	
Principal Investigator (60 hr @ $34.02/hr)	2,041.
Field Supervisor (80 hr @ $13.)	1,040.
Lab Supervisor (2080 hr @ $10/hr)	20,800.
Data Analysis (280 hr @ $11/hr)	3,080.
Irregular Help (4884 hr @ $7.50/hr)	36,630.
Subtotal $63,591.	
Fringe Benefits	
PI & Supervisors (33.5%)	8,000.
Data Analysis & I H (@23.5%)	9,331.
Subtotal $17,331	
Operating Expenses	
Barbecue baskets (100 @ 12 ea)	1,200.
Computer Rental (325 hrs @ 1.45/hr)	471.
Misc. Office Expenses (disks, FAX, phone)	240.
Boat Rentals (65 hr @ 30/hr	1,950.
Misc. Report Preparation Items (Xerox)	150.
Laboratory supplies (forceps, vials, preservative	1,350.
Subtotal $ 5,361.	
Travel	
Vehicle Rental (1 @ $7.00/day & 0.34/mi)	1,554.
Trips to Seattle & Walla (coordination)	850.
Subtotal $ 2,404.	
Project Subtotal $88,687.	
Overhead	
(U of I @ 15%)	13,303.
(NBS @ 10%)	10,199.
Subtotal $23,502.	
Project Total $112,189.	

BENTHIC INVERTEBRATE DRIFT

IN THE TAILWATER OF THREE

LOWER SNAKE RIVER DAMS

by

David H. Bennett
Department of Fish and Wildlife Resources
College of Forestry, Wildlife and Range Sciences
University of Idaho
Moscow, Idaho 83844-1136
Telephone 208/885-6337
FAX 208/885-9080

April 1995

INTRODUCTION

The importance of benthic macroinvertebrates as food to downstream migrating yearling and subyearling rearing chinook salmon has been demonstrated by Bennett and Shrier (1986) and Curet (1993). Yearling and subyearling chinooks fed on a variety of benthic macroinvertebrates especially dipterans. Many of these were recently eaten based on their live appearance in the stomachs. No one knows whether these organisms are fed upon within the water column as drift or actually removed from the substrate. No known data are available on drift downstream of any of the Snake and Columbia river dams.

Benthic macroinvertebrates in the drift may also be used as an indicator of water quality conditions. Gas supersaturation may limit the survival and buoyancy of benthic macroinvertebrates under conditions of high supersaturation in tailwaters.

Invertebrate drift has been widely studied in smaller streams although ecologically remains a mystery (Waters 1969; Brittain and Eikeland 1988). Less is known about this behavior in large rivers. Benke et al. (1991) studied patterns of invertebrate drift in the Ogeechee River, a sixth order river in the southeastern United States. They found drift quantities were among the highest reported in the literature with average densities ranging from 20.4 to 22.8 organisms/m^3. Ephemeroptera, Coleoptera, Plecoptera, and Tricoptera contributed most to the drift. Benke et al. (1991) also speculated that habitat quality contributed to the drift. Sagar and Glova (1992) assessed the temporal-spatial patterns of drift in a large New Zealand River. Few taxa were collected and densities were 0.96 organisms/m^3, considerably lower than those reported by Benke et al. (1991) for a large river in the southeastern U.S. The purpose of this proposal is to quantify and assess seasonal differences in drift in the Lower Granite tailwater and qualify drift in the tailwaters of Little Goose and Lower Monumental dams.

OBJECTIVES

1. To qualify benthic macroinvertebrate drift in the tailraces of Lower Granite, Little Goose and Lower Monumental dams;

2. To assess temporal variation in the tailwater of Lower Granite D[illegible]

3. To quantify shoreline benthic m [illegible] ower Granite Dam.

Drift nets with surface areas [illegible]

replicate for approximately 5-45 mi [illegible]

immediately off the bottom in the t [illegible] and

Lower Monumental dams. Larger n [illegible]

preferred but debris plugging of net [illegible] m

dusk to dawn to identify nocturnal c [illegible] light

has been shown to be the time of m [illegible] s

would be positioned on posts to achi [illegible] ess of

tailwater elevation. Replicate nets w [illegible] e

quantity of drift.

Location in the tailwater woul [illegible]

accessible from shore. If possible, sa [illegible] would be within a 1/4-1/2 mile of the dam depending upon shoreline accessibility.

In Lower Granite Reservoir, we would sample one night every 2 weeks during the migration of yearling salmon. Thereafter in the summer and fall, sampling would be conducted on 2-3 nights during each of the summer and fall seasons.

could be further to get away from spill turbulence, move downriver beyond estimated TDG mixing zone.

BiOp will limit voluntary spill @ LGR in lieu of transportation. need to take the opportunity to compare spill @ LGR, no spill vs.

In the tailwaters of Little Goose and Lower Monumental dams, replicate sampling would be conducted as in Lower Granite for 2 nights/season. A similar pattern of sampling (5-45 minutes) is anticipated to qualify drift below these dams.

REFERENCES

Benke, A.C., K.A. Parsons, and S. M. Dhar. 1991. Population and community patterns of invertebrate drift in an unregulated coastal plain river. Canadian Journal of Fisheries and Aquatic Sciences 48:811-823.

Bennett, D.H., and F.C. Shrier. 1986. Effects of sediment dredging and in-water disposal on fishes in Lower Granite Reservoir, Idaho-Washington. Completion Report. U.S. Army Corps of Engineers, Walla Walla, Washington.

Brittain, J.E. and T.J. Eikeland. 1988. Invertebrate drift - a review. Hydrobiologia 166:77-93.

Curet, T. 1993. Habitat use, food habits and the influence of predation on subyearling chinook salmon in Lower Granite and Little Goose reservoirs. Master's thesis. University of Idaho, Moscow.

Sagar, P.M. and G.J. Glova. 1992. Invertebrate drift in a large, braided New Zealand river. Freshwater Biology 27:405-416.

Waters, T.F. 1969. Invertebrate drift-ecology and significance to stream fishes. Pages 121-134. *In* T.G. Northcote (editor). Symposium on salmon and trout streams. University of British Columbia, Vancouver, B.C.

PROPOSED BUDGET

ITEM		COST
Salaries		
Principal Investigator (40 hr @ $34.02/hr)		1,361.
Lab Supervisor (640 hr @ $10/hr)		6,400.
Data Analysis (60 hr @ $11/hr)		660.
Irregular Help (696 hr @ $7.50/hr)		5,220.
	Subtotal $13,641.	
Fringe Benefits		
PI & Supervisors (33.5%)		2,600.
Data Analysis & I H (@23.5%)		1,241.
	Subtotal $3,841.	
Operating Expenses		
Drift Nets (4 @ 150 ea)		600.
Anchor devices and posts		250.
Computer Rental (45 hrs @ 1.45/hr)		66.
Misc. Office Expenses (disks, FAX, phone)		120.
Boat Rentals (45 hr @ 30/hr		1,350.
Misc. Report Preparation Items (Xerox, slide film)		50.
Laboratory supplies (forceps, vials, preservative		850.
	Subtotal $ 3,286.	
Travel		
Vehicle Rental (1 @ $7.00/day & 0.34/mi)		3850.
	Subtotal $ 3,850..	
	Project Subtotal $24,618.	
Overhead		
(U of I @ 15%)		3,693.
(NBS @ 10%)		2,831.
	Subtotal $6,524.	
	Project Total $31,142.	