# AN INVESTIGATION OF THE BOARDMAN RIVER BIOTA IN RESPONSE TO TEMPORARY DROUGHT CONDITIONS

THOMAS M. KELLY
MARINE CONSULTANT

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Traverse City Department of Power and Light
400 Boardman Avenue
Traverse City, MI 49684

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Thomas M. Kelly

## SUMMARY

1. On June 24 and July 1, 1981, I inspected and sampled the Boardman River below Brown Bridge Dam to evaluate the biological impact of an accidental closing of the spillway gates at the dam on May 22, 1981.

2. Analysis of stream bottom samples showed no radical differences between the affected and control areas. Most types of organisms were able to either withstand the temporary drought or recolonize the affected areas.

3. It is not possible to determine the extent of immediate mortality to fish and fish food organisms caused by the dam shutoff.

4. The scientific literature on fluctuating stream environments uniformly shows a loss of biological production with such conditions. Future operation of the dams should be done in such a way as to maintain stable river flow.

5. Discharge recording instruments should be installed at all dams. A telephone monitor should be installed at the Mayfield U.S.G.S. gage to permit instantaneous remote readings of river discharge.

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## INTRODUCTION

On May 22, 1981, the Brown Bridge Dam spillway gates were accidently closed and remained closed for approximately 1.5 hours. This closure stopped the discharge at Brown Bridge and lowered the downstream river level, exposing portions of the stream bottom to the air. This investigation was done to determine the effects of this temporary "drought" condition on the river's benthic invertebrate fauna, with special consideration of fish food items.

## METHODS AND MATERIALS

Effects of the temporary drought condition were evaluated in three ways: 1) qualitative observation, 2) quantitative sampling, and 3) review of scientific literature.

Qualitative observations of the benthic invertebrate fauna were made in the Boardman River at the Garfield Road Bridge (T 26N, R 10W, Sec. 16), and at the Scharman Road Bridge (T 26N, R 10W, Sec. 22) on June 24, 1981. An attempt was made to compare the abundance of organisms in deep water with those found in shallow water areas that would have been exposed on May 22.

Further qualitative observations were made on July 1 of organisms associated with rooted plants, boulders, and submerged logs at "control" and "exposed" stations. A second "control" station immediately below the Mayfield gage was also examined.

Quantitative sampling of bentic invertebrates took place on July 1, 1981, 39 days after the drought incident. Details of the two stations are given in Table 1.

TABLE 1. Physical Characteristics of Sampling Sites

| | Control | Exposed |
|---|---|---|
| Location: | 0.25 mile below Scharman Road | 0.15 miles below Mayfield gage |
| Depth (on July 1): | 15 inches | 5 inches |
| Water Temperature: | 68°F | 67°F |
| Current (apx): | 1 ft./sec. | 1 ft./sec. |
| Bottom: | Riffle, unsorted gravel, some *Chara* and grass. Small clam shells, logs and twigs. | Riffle, unsorted gravel smaller average size that control, few logs, some *Potamogeton* sp. |

Station locations were selected with reference to the Mayfield discharge gage height on May 22. Summary information on river stages was obtained from the U.S. Geological Survey. The complete Mayfield hydrograph for May was not available at the time this report was written. Average river stages and discharges for May 21 - 23 are presented in Table 2.

TABLE 2. River Stages and Discharge, Mayfield

| | Daily Average River Stage (feet) | Average Discharge (cfs) |
|---|---|---|
| May 21 | 3.51 | 167 |
| May 22 | 3.37 | 139 |
| May 23 | 3.37 | 139 |

The minimum stage recorded on May 22 was 2.78 feet, which corresponds with a discharge of 58 cfs. The 195 - 1973 average discharge at Mayfield during May was 224 cfs. The average monthly low flow for May during the same period was 154 cfs. The Michigan Department of Natural Resources has recommended a minimum flow of 120 cfs be maintained to insure sufficient water for fish and canoeing. (Energy and Porter, 1979.)

Benthic samples were collected with a circular sieve pulled through the substrate. The sieve penetrated 2.4 inches into the bottom. Screen size was approximentely 0.05 inches. Each sample covered 28.5 square inches of stream bottom and had a volume of 106.3 cubic inches. Large rocks were carefully cleaned of organisms and the remaining bottom material was taken to the laboratory for subsequent sorting and identification of organisms. For the sake of economy samples were tabulated only to the level of order. Samples were preserved in 70% alcohol and are available for more detailed taxonomic analysis if the need arises.

TABLE 3. Benthic Invertebrates Collected July 1

Control Station

| | | |
|---|---|---|
| Plecoptera - Stone flies | - | 2 |
| Ephemeroptera - Mayflies | - | 32 |
| Trichoptera - Caddis flies | - | 73 |
| Diptera - Flies, midges | - | 23 |
| Pelecypoda - clams | - | 5 |
| Unidentified insect | - | 1 |
| Total | | 136 |

Exposed Station

| | | |
|---|---|---|
| Ephemeroptera | - | 21 |
| Trichoptera | - | 24 |
| Diptera | - | 7 |
| Coleoptera - Aquatic beetle | - | 1 |
| Annelida - Segmented worms | - | 79 |
| Turbellaria - Flat worms | - | 12 |
| Pelecypoda | - | 126 |
| Total | | 270 |

## RESULTS AND DISCUSSION

Results of the quantitative sampling are presented in Table 3. Mayflies and caddisflies were slightly more abundant at the control station. A side from exposure affects, this may be partially explained by the larger average particle size at the control station, which would favor these organisms. The slight difference in substrate may also explain the abundance of small clams (Sphaerium sp.) and worms at the exposed station.

Observations of logs and large stones revealed net and case building caddisflies in both shallow and deep water. Caddis pupa cases were present in shallow water, indicating recent utilization of the exposed habitat (Caddis pupa stages last two to three weeks). Mayfly nymphs and black fly larve (Simulium) were also common on rocks and logs at all depths.

Organisms found living in the previously exposed bottom areas on July 1 were either able to withstand the short duration drought of May 22 or have colonized the area in the intervening 40 days.

Some organisms are especially adapted to survival of short term drought. Clams and pulmonate snails can close their shells. Caddis pupa are apparently protected by their cases. Some stone-flies and mayflies can crawl under rocks to prevent desiccation. Flatworms, oligocheate worms and some chironomid (fly) larve are also resistant to drying out (Hynes 1972).

Those organisms not able to move from the exposed areas and unable to seal themselves from the air would be killed. Many insects and small fishes probably perished due to lowered river level but the extent of the mortality is impossible to determine. The presence of most major invertebrate groups in the exposed stations indicates survival or colonization of the affected area's fauna. Colonization can occur from upstream by organisms drifting downstream with the current and by organisms swimming or crawling from downstream or adjacent deeper unaffected areas.

The impact of the drought incident would be expected to be most severe directly below Brown Bridge Dam. Further downstream groundwater inflow and tributary inputs would mitigate the loss of flow at Brown Bridge Dam.

## SUMMARY AND RECOMMENDATIONS

The drought incident of May 22, 1981, undoubtedly caused some mortality to aquatic invertebrates and small fishes stranded by the lowered river level. The extent of this mortality is not known, and given the apparent survival and/or colonization of affected bottom areas, the loss was probably not significant on a river-wide basis.

It is well known that streams with great variations in flow regime are less productive than stable streams (Hynes 1972). The implications for hydropower use for the Boardman River are obvious. Continual changes in river flow will reduce the habitat for fish and fish food organisms not adapted to surviving desiccation.

Continuous remote monitoring of reservoir level and turbine operation is critical to maintain stable river conditions. Alarm systems should be installed to warn of unexpected flow situations. A system to automatically regulate flow through the dam based on reservoir level would minimize unnecessary flow fluctuations. This system should be remotely monitored from Traverse City.

## REFERENCES

Emery and Porter, Inc., 1979. Final Report. Feasibility Assessment for renovating one or more of five existing dams on the Boardman River in Grand Traverse County. Lansing, MI.

Hynes, H.B.N., 1972. The Ecology of Running Waters. University of Toronto Press, Toronto. 555 p.