# Comparison of Stomach Contents and Condition of Two Catfish Species Living at Ambient Temperatures and in a Heated Discharge

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The New River, the main stream of the Kanawha River system, flows northward through Virginia and crosses the Virginia-West Virginia state line at Glen Lyn, Virginia. Heated waste water enters the New River from two Appalachian Power Company (APCo) discharges at Glen Lyn, Virginia. Stauffer (1975) studied the influence of temperature on the distribution of fish in the New River at this site and Cherry et al. (1974) evaluated the temperature preference of New River populations of channel catfish.

Other investigators have shown that fish prefer some temperatures and avoid others, depending partly on their thermal history and genetic background. Among others, these investigators include Doudoroff (1938); Fisher and Elson (1950); Fry (1947); Brett (1952); Garside and Tait (1958); Meldrim and Gift (1971); Stauffer et al. (1974, 1975a, 1975b); and Stauffer (1975). Only limited information is available, however, concerning the biology of fishes living at their preferred temperature in situ.

The data collected by Cherry et al. (1974) showed that channel catfish (*Ictalurus punctatus*) had a final laboratory temperature preference of 33.8°C. Field data collected by Stauffer et al. (1975a) indicated a final field temperature preference of 33.9 to 35°C for this species. Young-of-the-year channel catfish were collected at temperatures ranging from 22.2 to 35.0°C by Stauffer (1975). Although no information concerning the final laboratory and field temperature preference of the flathead catfish (*Pylodictus olivaris*) was available, field data indicated that young-of-the-year of this species were present at water temperatures 21.7 to 35°C (Stauffer et al. 1975b). In the light of the above data, we compared the stomach contents and condition of the young-of-the-year of these two species living at the highest ambient river temperature (26.7°C) and at their final field temperature preference (34.4°C) in a heated discharge.

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## Methods and Materials

Young-of-the-year channel catfish and flathead catfish were randomly selected from collections made after the application of rotenone on 3 and 4 September 1973 at a field sampling station upstream (26.7°C), here termed the reference site, and in the heated discharge (34.4°C) from the APCo's Glen Lyn plant (Stauffer et al. 1974), here called the heated site. A total of 41 channel catfish and 50 flathead catfish were selected from the heated site and the same number of each species from the reference site.

All fish were preserved in 10% formalin and transported to the laboratory, where they were weighed and measured. Stomachs from all specimens were removed and washed, and aquatic organisms were identified to genus when possible No evidence of postmortem digestion was observed.

A diversity index (Pielou 1969) was calculated from the abundance data for each stomach. We used a Student's-*t-test* to evaluate differences in the stomach contents of the two species collected at the two temperatures. Stauffer et al. (1974) calculated condition factors for these same fish, using the formula $K = W/L^3$, where K was the coefficient of condition, W the weight, and L the fork length of the specimen. Nikolsky (1963) used this factor to determine the difference in condition between specimens of the same species captured in different habitats. The higher the condition factor (K), the more "healthy" the fish (Nikolsky 1963).

## Results and Discussion

The number of taxa represented in the stomachs was 13 at the reference site and 9 at the heated site for channel catfish and 9 at the reference site and 12 at the heated site for flathead catfish (Table 1).

Results from Student's *t-tests* showed that for the channel catfish, there were significantly ($P = 0.05$, df = 80) more taxa and a higher diversity index value in stomachs from the reference site (2.8 taxa per stomach and diversity of 0.32) than in the stomachs from the heated site (3.4 taxa per stomach and a diversity of 0.65). However, there was a significantly greater ($P = 0.05$, df = 80) total number of organisms in the stomachs of the fish from the heated site (Table 1). The stomachs of flathead catfish from the heated site contained a significantly greater ($P = 0.05$, df = 98) number of species and total number of organisms than did

*Table 1. Mean number of organisms per stomach (T = trace, < 0.05) in channel catfish and flathead catfish collected in the heated effluent of a power plant and in unheated "reference" water, New River, Virginia, 1973.*

| Taxon | Channel Catfish | | Flathead Catfish | |
|---|---|---|---|---|
| | Heated | Reference | Heated | Reference |
| Astacidae | | | | |
| *Cambarus* | | | T | |
| Ephemeridae | | | | |
| *Hexagenis* | | | | T |
| Heptageniidae | | | | |
| *Stenonema* | 0.1 | 0.1 | 0.5 | 0.2 |
| Baetidae | | | | |
| *Baetis* | 2.0 | 8.3 | 12.6 | 9.8 |
| *Caenis* | 0.1 | | T | |
| *Ephemerella* | | T | | |
| *Isonychia* | | 0.3 | 0.4 | 4.6 |
| *Pseudocloeon* | | T | T | |
| *Tricorythodes* | | 1.2 | | |
| Coenagrionidae | | | | |
| *Agria* | | T | T | |
| Corydalidae | | | | |
| *Corydalus* | | | 0.5 | 0.2 |
| Hydropsychidae | | | | |
| *Hydropsyche* | 0.7 | 3.4 | 0.9 | 0.8 |
| *Macronemum* | T | T | | T |
| Psephenidae | | | | |
| *Psephenus* | | | T | |
| Elmidae | | | | |
| *Macronychus* | | T | | |
| *Optioservus* | | T | | |
| *Stenelmis* | | T | | |
| Tipulidae | | | | |
| *Antocha* | T | 0.2 | | |
| *Tipula* | | | T | |
| Psychodidae | 1.7 | 0.3 | 0.2 | T |
| Simuliidae | | | | |
| *Simulium* | | T | | T |
| Chironomidae | 40.4 | 4.6 | 17.8 | 0.1 |
| Mean number of organisms per stomach | 46.7 | 18.5 | 33.7 | 16.3 |
| Mean diversity per stomach | 0.32 | 0.65 | 0.49 | 0.38 |
| Mean number of taxa per stomach | 2.8 | 3.4 | 3.3 | 2.3 |

the stomachs of fish collected at the reference site; however, there was no significant difference in diversity between the heated and reference sites.

There was a significant difference ($P = 0.05$) in the number of Chironomidae per stomach between the two areas for both species. The channel catfish stomachs from the heated areas contained a mean of 40.4 chironomid larvae per stomach whereas the mean for stomachs from the reference site was only 4.6. The means for the flathead catfish stomachs were 17.8 in fish from the heated areas and 0.08 in fish from the reference site. Eight genera of Chironomidae were present among more than 550 larvae from about half of the channel catfish stomachs from both sites. *Cardiocladius* was dominant at both sites, making up 95% of the larvae at the heated site and 75% at the reference site. *Polypedilum* clearly ranked next at the heated site, but *Polypedilum*, *Eukiefieriella*, and *Orthocladius* were equally abundant at the reference site. The other four genera were uncommon; *Cryptochironomus* occurred in small numbers at both sites and *Cricotopus*, *Chironomus*, and *Larsia* occurred only at the reference site.

There was also a significant difference ($P = 0.05$, df = 80) in the number of mayfly nymphs per channel catfish stomach between the two areas. The stomachs from the heated areas contained a mean of 2.2 nymphs and those from the reference areas, 9.9. The number of mayfly nymphs per stomach in flathead catfish from the two areas (13 in the heated site and 14.6 in the reference site) did not differ significantly.

Preliminary results from another study now being conducted by one of us (Wilson) indicate that, during the times of the year when discharge temperatures exceed 33.3°C, the number of species and diversity of the macrobenthic community decreases; relative abundance of Chironomidae larvae at the heated discharge site increases; and the relative abundance of mayfly nymph decreases. On the basis of a comparison of stomach contents with the composition of the macrobenthic community at each station, we believe that young-of-the-year channel catfish were nonselectively eating food organisms present at both stations, since the composition of stomach contents was similar to the composition of the benthic community at each station. The contents of stomachs of flathead catfish from the heated site, however, were different from the fauna available in the substrate at the heated site — indicating that the fish were either moving out of the heated area to feed or were selectively feeding on organisms (particularly mayflies) which were in the substrate or drifted into the heated area.

As shown by Stauffer et al. (1974), condition factors were significantly ($P = 0.05$) lower for fish of both species captured in the heated area than for the reference area. The factors for channel catfish were

1.18 for fish from the heated area and 1.23 for those from the reference area; the respective values for flathead catfish were 1.11 and 1.35. Several mechanisms may be involved in lowering the condition factors of fish. The most obvious is the lack of food organisms. However, on the basis of our sampling of macroinvertebrates and the fact that only 4.3% of the stomachs were empty, it is doubtful that lack of food significantly affected the condition factors. It is also possible that food organisms in the heated effluent were ingested in less volume or that they contained a lower usable caloric content.

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