

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

ROUGE RIVER AREA OF CONCERN
FISH TUMOR OR OTHER DEFORMITY INVESTIGATION
2013

INTRODUCTION

The Rouge River Area of Concern includes the entire Rouge River watershed of approximately 466 square miles in southeastern Michigan. The Rouge River Area of Concern is listed for 14 beneficial use impairments (BUI), including "Fish Tumors or Other Deformities". Several studies have associated internal and external tumors in fish with carcinogens in sediment and water at several locations in North America, and they were summarized by Baumann et al. (1996). Specifically, epidermal and liver tumors in bullhead (*Ameiurus* spp.) and white sucker (*Catostomus commersonii*) are strongly correlated with the presence of polynuclear aromatic hydrocarbons (PAH).

A fish community survey of the Rouge River watershed was conducted in July and August 1986 by the Michigan Department of Natural Resources (SEMCOG, 1989). During that study the incidence of external lesions on the fish was recorded. Brown, black, and yellow bullhead (*A. nebulosus*, *A. melas*, and *A. natalis*) were collected during the survey but only 12 bullhead were collected overall, and none of the bullhead had external neoplasms (tumors). White sucker were much more numerous with 579 collected, 23 of which (4%) had external lesions; it was noted that these lesions were probably caused by anchorworms (a parasitic copepod).

A spatial trend in the distribution of those fish with lesions was apparent in the 1986 survey. White sucker in the Upper Branch of the Rouge River had an occurrence rate of 6.5%, and white sucker in the Main Branch (between Troy at the upstream end and Detroit downstream) had an occurrence rate of 6.3%. No lesions were observed on white sucker collected in the Middle and Lower Branches. It is important to note that tumors are more likely to occur in older fish (Baumann 2002) however age data are not available for the fish collected in 1986. The prevalence of external lesions in white sucker from 3 relatively pristine areas ranges from 3.4% to 8.6% (Baumann et al., 1996) with an overall average of 5.2%.

The Michigan Department of Environmental Quality, Water Resources Division, conducted a survey of the Rouge River Area of Concern in October 2013 with a goal of determining dermal lesion rates in white sucker in the Main Branch Rouge River and in the Upper Branch Rouge River.

SUMMARY

1. White sucker were collected from one reach of the Main Branch Rouge River downstream of the Ford Dam and from two reaches of the Upper Branch Rouge River.

2. The fish were examined for dermal lesions, neoplasms, and other external anomalies.
3. Dermal lesions attributable to anchorworms were observed on 24% of the white sucker collected from the Main Branch and on 2% of the white sucker collected from the Upper Branch Rouge River.
4. A dermal neoplasm was observed on one white sucker collected from the Main Branch Rouge River. This translates to an upper 95% confidence interval estimate of 12.8% of the population in the survey reach having similar dermal neoplasms. No dermal neoplasms were observed on white sucker collected from the Upper Branch Rouge River.
5. The estimated proportion of white sucker from the Main Branch Rouge River with dermal neoplasms was not statistically different than the estimated proportion in the Upper Branch Rouge River population, however statistical power was low.

METHODS

Standard electrofishing gear was used to collect white sucker from the Main Branch Rouge River downstream of the Ford Dam and from two reaches of the Upper Branch Rouge River (Figure 1). Other fish species encountered while electrofishing were also collected and held for inspection. All fish were held in a live well until the end of each electrofishing run and were then examined for gross external lesions or other dermal anomalies. Digital photographs were taken of examples of fish with lesions or other anomalies. Total length was measured and scale samples collected from a subsample of 20 white suckers at each sampling site. All fish were released after examination.

White sucker scales were aged by Great Lakes Environmental Center (Traverse City, Michigan) using techniques outlined by Nielsen and Johnson (1989). Scales were cleaned, compressed between two glass microscope slides, and examined using low-power magnification.

Confidence intervals about the estimated percent occurrence of dermal neoplasms were calculated based on a binomial distribution (Sprent and Smeeton, 2001). A comparison of the rate of occurrence of neoplasms between Upper Branch and Main Branch Rouge River samples was made using Fisher's exact test for independence. A one proportion test was used to compare the Main Branch rate estimate with the presumed background rate of 5% (based on Baumann et al., 1996). Confidence interval estimates and statistical comparisons were made using the Minitab 15 software package.

RESULTS AND DISCUSSION

A total of 41 and 147 white sucker were collected from the Main Branch and Upper Branch Rouge River, respectively, in 2013 (Table 1). A high percentage of the white sucker collected from the Main Branch Rouge River had dermal lesions which most likely were caused by anchorworms (*Lernaea* spp.), a common freshwater copepod with a parasitic life stage. Figures 2 through 9 show typical lesions observed during the survey. Figure 10 shows an unusually large dermal lesion that may not have been caused by anchor worms. Both Figures 11 and 12 are photos of the same white sucker with an anchorworm attached and showing the associated lesion.

In addition to the white sucker, one channel catfish (*Ictalurus punctatus*) and eight northern pike (*Esox lucius*) were collected from the Main Branch Rouge River. No

external anomalies were observed in the catfish or pike. One yellow bullhead and 38 northern hogsucker (*Hypentelium nigricans*) were collected from the Upper Branch Rouge River in addition to the white sucker. Again, no external anomalies were observed in the non-target species.

One white sucker was observed with a dermal neoplasm (Figures 13 and 14). The fish was collected from the Main Branch Rouge River and represents 2.4% of the total catch from that reach (Table 1). No dermal neoplasms were observed on the white sucker collected from the Upper Branch Rouge River reaches. There was no statistically significant difference in the percentage of dermal neoplasms observed in the Main Branch compared to the Upper Branch Rouge River (Fisher's exact test P-value = 0.22); however, with only 41 samples from the Main Branch the power to detect a difference was low. More specifically, with the given sample sizes we only have sufficient power to detect a difference in proportions of about 20%. If the sample size were 100 from both the Upper and Main Branches we would be able to detect a difference of about 10%.

The white sucker collected from the Main Branch tended to be both larger and older than those collected from the Upper Branch stations (Table 2). This could explain the observed difference in neoplasm proportion between the two populations; older fish are more likely to develop neoplasms having been exposed to potential tumor causing agents (i.e. toxins, parasites, or pathogens) for a longer period of time.

The one white sucker with a dermal neoplasm represents 0.5% of the 188 white sucker collected from all three Rouge River reaches sampled in the 2013 survey. The 95% confidence interval on the overall estimated percent of white sucker with dermal neoplasms ranged from 0.01% to 2.9%. Taken as a whole, the proportion of dermal neoplasms observed in this survey is statistically significantly less ($p = 0.001$) than the average background proportion of 5% suggested by Baumann et al. (1996).

The results of this survey indicate that the proportion of white sucker in the Rouge River with dermal neoplasms is low; if the "Fish Tumors or Other Deformities" BUI is based solely on external lesions and neoplasms then that BUI could be removed. Baumann (2010) strongly recommends evaluating the incidence of neoplastic liver tumors as evidence of exposure to contaminants, arguing that external lesions can be caused by a combination of many factors, including toxins, parasites, and bacterial or viral pathogens. An evaluation of the incidence of liver tumors would require an intensive survey but would provide a definitive answer. However, if in general there is a correlation between external neoplasms and liver tumors, the results of the 2013 study would indicate that liver tumors in white sucker are likely to be relatively rare.

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Table 1. Sample sizes and estimated percent dermal neoplasm in white sucker collected from the Main and Upper Branches of the Rouge River in 2013 and 1986.

	2013 Survey		1986 Survey	
	Main Rouge River	Upper Rouge River	Main Rouge River	Upper Rouge River
Total Number Collected	41	147	270	92
Number w/Dermal Lesion(s)	10	3	17	6
% w/Dermal Lesion(s)	24.4	2.0	6.3	6.5
Number w/Dermal Neoplasm	1	0	na	na
% w/Dermal Neoplasm	2.4	0	na	na
95% Confidence Limit on Estimated Percent w/Neoplasm	0.1 - 12.8%	0 - 2.0%	na	na

Table 2. Age structure of white sucker collected from the Rouge River in 2013.

Fish Age	Percent at Age	
	Upper Branch	Main Branch
2	25	10
3	45	35
4	30	30
5		20
6		5
Total	100	100



Figure 1. Map of River Rouge Area of Concern showing 2013 fish tumor survey sampling sites.



Figure 2.



Figure 3.



Figure 4.



Figure 5.



Figure 6.



Figure 7.



Figure 8.



Figure 9.



Figure 10.



Figure 11.



Figure 12.



Figure 13



Figure 14.