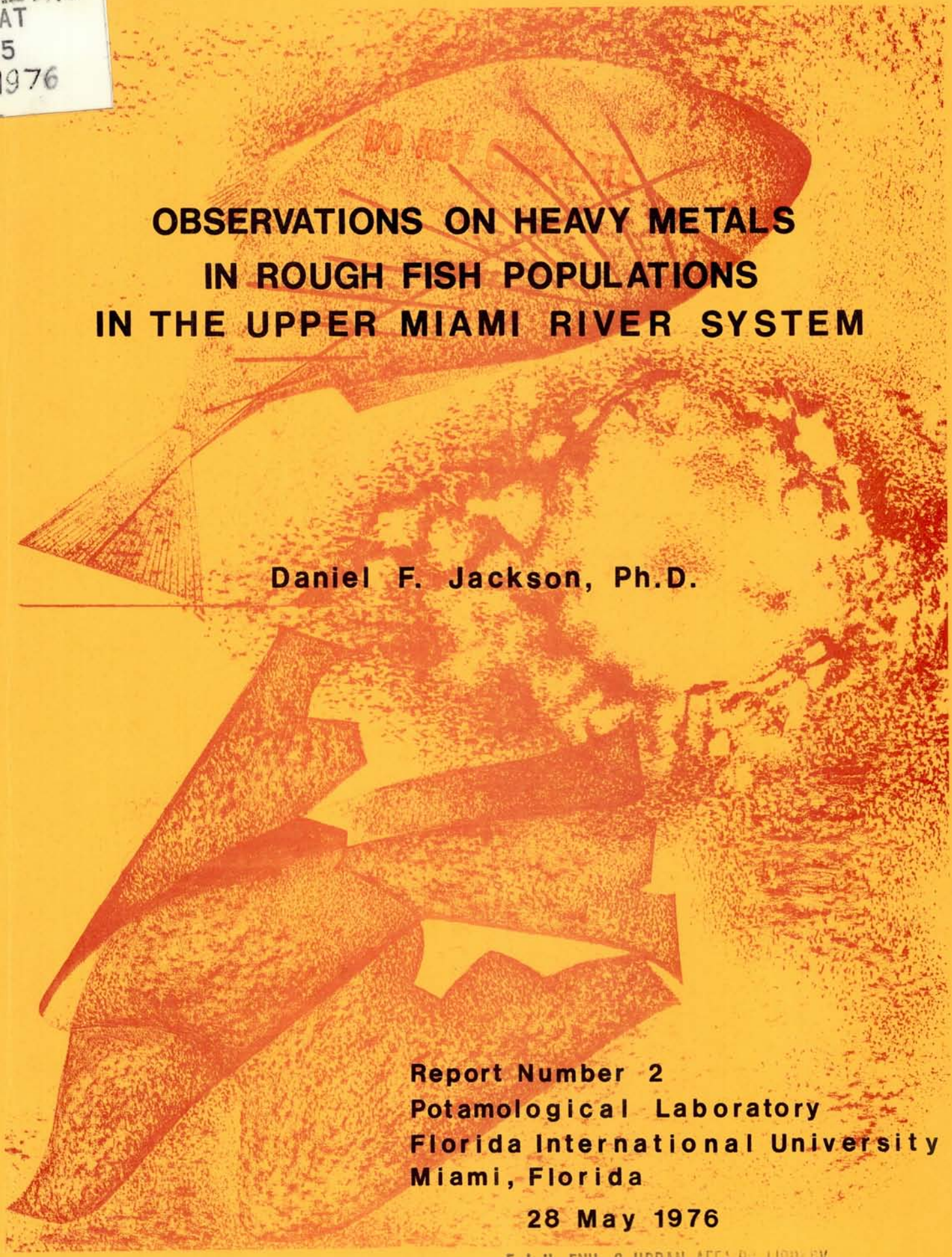

OBSERVATIONS ON HEAVY METALS IN ROUGH FISH POPULATIONS IN THE UPPER MIAMI RIVER SYSTEM

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INTRODUCTION

One dolphin is reportedly to have said to another dolphin, "Although humans make sounds with their mouths and occasionally look at each other, there is no solid evidence that they actually communicate among themselves." This statement seems to be especially true when one is discussing water quality problems. The lack of action taken by any agency to solve, to improve, or even to identify the ills of Biscayne Bay, the Miami River System or water from the tap is appalling.

The following report reveals some of the environmental interactions that are occurring in Dade County waters right under our eyes. If changes such as these are taking place in the open waterways at the organismal level, what must be happening within the hidden cellular water system of man?

To add another piece of data to help solve the Dade County water quality problem, the Potamological Laboratory of Florida International University participated in the MUDFISH ROUNDUP. This program was sponsored by the Miami River Inter-City Board as part of the 1976 Regatta. The Mudfish Roundup was designed by Joseph Podgor, Jr., Tom Rech and Larry Worley of Miami Springs, Florida. The roundup was held April 25, 1976 between 7:30 a.m. and 4 p.m. The rules of the contest may be found in Figure 1.

The purpose of the roundup was to remove trash fish from the waters of the Upper Miami River. The rationale behind this

FIGURE 1.

MUDFISH ROUNDUP

In keeping with the goals of improving the Miami River/Canal System and providing for its use as a recreational resource, The Miami River Inter-City Board is proud to announce that this year's Regatta will feature a MUDFISH ROUND-UP, a special kind of fishing contest open to all ages, on Sunday April 25. Hundreds of dollars worth of prizes will be awarded to winners in five categories including awards for the largest mudfish and the largest gar. Special Merit awards will also be made as extra surprises during the awards ceremony Sunday afternoon.

The reasons for the ROUND-UP are simple. In the past, the Miami River/Canal System has suffered the unfortunate effects of fishkills which resulted from a deterioration of the water quality by various sources of pollution. Whenever such fishkills occur, the first species to go are usually those gamefish we value the most. As a result, a comparative overabundance of undesirable "trash-fish" (mudfish, gar, and the non-native exotics) exists in the River System today. These trashfish compete with our gamefish for food and habitat; it has been said that if we remove one pound of mudfish from a canal, we make room for one pound of bass. Therefore, the aim of the MUDFISH ROUND-UP is to restore a more balanced situation to the fish populations of our favorite River and its tributaries.

This year's officials are Tom Rech and Larry Worley of Miami Springs. Fishing will begin after registration at the official Weigh Station starting at 7:30 a.m. until closing time at 4:00 p.m. All entries must be brought in for weighing before 4:00 p.m. in order to be eligible. For more information and entry forms contact ROUND-UP Headquarters at Tom's Barbershop, 246 Westward Drive, Miami Springs, Florida, 33166; or phone Regatta offices at 883-8915.

RULES: FIRST ANNUAL MIAMI RIVER REGATTA MUDFISH ROUND-UP

1. All Mudfish, Gar, and "Exotics" will be eligible for prizes in the following prize categories:
   a) *First Place and Grand Prize* — awarded to heaviest catch of eligible fish in any combination.
   b) *Second Place* — awarded to second heaviest combined catch.
   c) *Third Place* — awarded to third heaviest combined catch.
   d) *Blue Ribbon and Prize for Largest Mudfish*
   e) *Blue Ribbon and Prize for Largest Gar*
   f) *Judge's Special Merit Awards*

   Entrants must be present to collect prizes which will be awarded to the winners of each category.
2. Any bass, bream, spec, tarpon, snook, shiner, catfish or other gamefish are not eligible entries. Any participant entering any of these fish will be immediately disqualified. No part of any of the above-mentioned fish, with the exception of shiners, may be used for bait.
3. All entrants must register at the official Weigh Station before the start of fishing, and all fish weighted in by entrant must be caught and landed on the same day of the "ROUND-UP" by the entrant registered.
4. All Florida Game and Freshwater Fish Commission Rules must be strictly observed. All fish entered must be caught on rod-and-reel or pole-and-line tackle only.
5. Fishing will begin after registration which opens at 7:30 A.M. The ROUND-UP will be over at 4:00 P.M.; no entries will be permitted after that time. Fish to be entered must be prepared on a stringer ready for weighing.
6. No fishing permitted within fifty yards of the Weigh Station.
7. All youngsters seventeen (17) years old and under must have signature of parent or legal guardian on registration form before starting fishing.
8. All decisions of the officials will be final. Any violation of these rules will result in disqualification.

REGISTRATION AND ENTRY FORM:

NAME:_____ ADDRESS:_____ PHONE:_____

AGE:_____ PLACE WHERE FISH CAUGHT:_____

BAIT AND TACKLE USED:_____ LURES USED (if any):_____

ENTRIES: Weight of Combined Catch:_____ Largest Mudfish:_____ Largest Gar:_____

WAIVER OF LIABILITY:

The undersigned waivers all rights and claims against the cities, officers, committee members, individuals, and organizations and officials soonsoring or working at the Miami River Regatta, and land owners whose lands border the Miami River/Canal System, both individually and severally and acknowledges the above organizations, individuals and landowners assume no responsibility for accidents, injuries or loss of equipment prior to, during, or after the event. The undersigned parent of children under 18 years of age hereby agree to save said officers, committee members, individuals, organizations and landowners harmless from any claims of said minors and attest to the swimming ability of said minors. Entrant under 18 years of age must have waiver signed by themselves and their parents or guardian.

Signed _____ Parent_____ Date_____

Signed _____ Parent_____ Date_____

program is the reduction of the large population of undesirable fishes which compete for both food and space with the game species. Since fish reflect the quality of the waters in which they live and because the waters of the Upper Miami River have a great influence on drinking water quality, it was decided that heavy metal determinations on the trash fish would yield valuable information.

PROCEDURES

Fish returned to the roundup station were weighed, measured and part of the exaxial muscles were removed from the midbody of each fish. These samples were immediately placed in separate bottles (Figures 2 and 3) and put in an ice chest to be taken to the laboratory at Florida International University. At the laboratory the samples were digested with 10 ml of $36NH_2SO_4$ followed by 10 ml of $16NH_2SO_4$, then placed for 16 hours in a water bath at 60°C. The samples were removed from the bath, diluted to 50 ml and then run against an acid blank.

Determinations for mercury, lead and cadmium were made according to the operational methods of Perkin Elmer. The unit used to make the determinations was a Perkin Elmer Model 503 Atomic Absorption Spectrophotometer (Figure 4). All determinations were made by Mr. Fred Curtis, Jr. He and Mr. Georg Koszulinski prepared the fish samples at the Mudfish Roundup.

Figure 2. Preparations of gar specimens for heavy metal determinations by Georg Koszulinski and Fred Curtis (with a watch). Photo courtesy of Joe Podgor.

Figure 3. Mr. Georg Koszulinski with fascinated observers. Photo courtesy of Joe Podgor.

RESULTS

Table 1 lists the results from the fishes caught in the Mudfish Roundup. Only 1/8 or 20 fishermen reported on their catch. These 20 individuals caught collectively 59.06 lbs (26.85 kg) of trash fish or nearly 3 lbs/person. It is interesting that of the total catch 23.7% were native trash fish (bowfins and gars) while the remaining 76.3% were exotic or introduced species such as oscar, acara, tilapia and cichlid. Figure 5 shows a typical catch of these exotic fishes. The mean values for lead, cadmium and mercury found in representative fishes caught in the roundup are given in Figures 2 and 3. The five fishes listed made up 99% of the total catch. The value for the American Eel is for a single specimen. The eel was an accidental capture (Table 2).

Table 1. Results of the Miami River Inter-City Board Mudfish Roundup April 25, 1976.

Number of entries	162		
Number of returns	20		
Total Day Catch	59.0625 lbs	(26.85 kg)	
Bowfins	8.375	(3.81 kg)	14.2%
Gars	5.625	(2.56 kg)	9.5%
Exotics	45.0625	(20.48 kg)	76.3%

Table 2. Mean Values of Heavy Metals in Five Different Fishes From the Upper Miami River System Collected April 25, 1976.

	Wt. kg	Lead ppm Wet Wt.	Cadmium ppm Wet Wt.	Mercury ppm Wet Wt.
Gar *Lepisosteus platyrhincus*	.306	14.4	.710	.373
Eel *Anguilla rostrata*	.283	13.2	.099	.283
Bowfin *Amia calva*	1.950	11.0	.108	.528
Oscar *Astronotus ocellatus*	.348	7.8	.082	.223
Black Acara *Cichlasoma bimaculatum*	.311	6.9	.046	.248

DISCUSSION

It is apparent from Table 2 that all the species of fish had extremely high lead values. These ranged from 6.9 ppm in the Black Acara to 14.4 ppm in the Gar. The range of the cadmium values was a low of .046 ppm (46 ppb) to .710 ppm (710 ppb) in the Gar. The mercury values ranged from a low of .223 ppm (223 ppb) in the Oscar to .528 ppm (528 ppb) in the Bowfin. In all cases the heavy metal concentrations were the greatest in the native fishes and the lowest in the exotics (Table 3).

Figure 4. Mr. Fred Curtis operating the Perkin Elmer Model 503 Atomic Absorption Spectrophotometer.

Table 3. Mean Values of Heavy Metals in Five Different Fishes From the Upper Miami River System Collected April 25, 1976, arranged in descending order. Values expressed in ppm wet weight.

Lead		Cadmium		Mercury	
Gar	14.4	Gar	.710	Bowfin	.528
Eel	13.2	Bowfin	.108	Gar	.373
Bowfin	11.0	Eel	.099	Eel	.283
Oscar	7.8	Oscar	.082	Acara	.248
Acara	6.9	Acara	.046	Oscar	.223

What do these results indicate? It would seem that fewer rough native fishes were caught than exotics. The reason may well be that the Bowfins and the Gars are becoming vanishing species. The Bowfin and the Gar are both very primitive and ancient fishes. It is also obvious that they contain high levels of heavy metals. These heavy metals undoubtedly have reduced the fishes' environmental tolerance, making them more vulnerable to disease, sterility and extinction. The native trash fish are also finding greater competition for food from exotics such as the Oscar and Acara. These fishes seem to concentrate lesser amounts of heavy metals.

With the weakening of the Gars and Bowfins by heavy metals, the exotics have a greater opportunity for population explosion. As a result of the increasing number of exotics, good fishing in the Miami River is becoming a memory of the past.

Figure 5. A catch of exotic fishes from the Upper Miami [illegible]
(7 lb 10 oz);April 25, 1976. Photo courtesy of Joe Podgor.

CONCLUSIONS

There is immediate need to evaluate the fish populations of the Upper Miami River System and correct, if possible, the ecological imbalance which seems to exist. This action should improve fishing. The edibility of the fishes is another matter. The single eel which was accidentally caught had a mercury content of .283 ppm. The World Health Organization's upper level of safe eating of fish containing mercury is .050 ppm of mercury. This means that any of the fish caught had mercury concentrations 4 to 10 times higher than has been determined to be safe to eat. What about the game fish in the Miami River, what are their mercury contents?

A fish reflects the water it lives in. The fish caught in the roundup had excessively high values of lead. The lead came from the automobiles. Roads parallel the river and are important sources of pollution. The fishes in the canals concentrate the lead, mercury and cadmium that enter the water. At some point in time the concentrations will reach such a level as to be debilitative or lethal. If fish can concentrate these heavy metals from the water and if man uses the same water for drinking, can man avoid accumulating lead, mercury or cadmium? The fishes of the Miami River System are good indicators of water quality.

ACKNOWLEDGMENTS

Special thanks are due Mr. Joseph Podgor, Jr., for the illustrations used in this report. Mr. Fred Curtis, Jr., made the heavy metal determinations and he and Georg Koszulinski devoted the entire Sunday of April 25 to preparing the fish samples.

Professor Neil Hout-Cooper, Division of Industrial Technology, is responsible for the production of this report. Mrs. Engles and Mrs. Rountree did the typing. Dr. Bettina B. Jackson as usual provided invaluable editorial assistance.

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Figure 6. Are the high concentrations of heavy metals in the gar and bowfin populations in the Upper Miami River responsible for their decline and possible extinction? Today the fish, tomorrow ... Photo courtesy of Joe Podgor.