Appendix 7-13: Stormwater Treatment Area 6 Follow-up Mercury Studies

Darren Rumbold, Larry Fink, Krysten Laine,
Francine Matson, Sharon Niemczyk, and Pete Rawlik

INTRODUCTION

This report summarizes mercury-related follow-up studies at Stormwater Treatment Area (STA) 6. These studies were conducted to provide information supplemental to that generated by the routine mercury compliance monitoring program for STA 6 in fulfillment of Condition 8.b. (4) of the U.S. Army Corps of Engineers (USACOE) Section 404 Dredge and Fill Permit (No.199404532). The details of the routine mercury compliance monitoring program at STA 6 is described in detail in the "*Mercury Monitoring and Reporting Plan for the Everglades Construction Project, the Central and Southern Florida Project, and the Everglades Protection Area*", and summarized in Appendix 7-9A (this report).

As previously reported (Rumbold and Rawlik, 2000), the mercury-monitoring program at STA 6 has revealed mercury concentrations in surface water and fish tissues that are frequently higher near the outflow as compared to the inflow. Because such occurrences were extremely infrequent at the prototype STA, the Everglades Nutrient Removal (ENR) Project, it was felt that these patterns warranted closer scrutiny. Moreover, as previously discussed (Rumbold and Rawlik, 2000), substantial uncertainties existed as to the cause, actual magnitude, statistical significance and environmental significance of the observed positive gradient in total mercury (THg) and methylmercury (MeHg) across the STA 6 treatment system. To reduce these uncertainties, short-term follow-up studies were undertaken at STA 6 in 1999.

STUDY SITE AND METHODS

STA 6, Section 1 is located at the southeastern corner of Hendry County and southwest corner of the Everglades Agricultural Area. STA 6, Section 1 has two treatment cells (Cell 5=252 ha and Cell 3=99 ha) designed to provide a total effective treatment area of 352 ha (870 acres, **Figure A7-13-1**; for additional details see SFWMD, 1997). The United States Sugar Corporation, (USSC), has operated the two cells as a storm water retention area since 1989. Approximately 4,210 ha of USSC's agricultural production area (Southern Division Ranch, Unit 2) drains into STA 6, Section 1 via a Supply Canal and existing pump station, G600, that continues to be under the operation

of USSC. Water flows from the Supply Canal to the treatment cells via inflow weirs (two for Cell 5 and one for Cell 3). Water then flows in an easterly direction and is discharged through six recently installed culverts (G-354 A-C for Cell 5 and G-393 A-C for Cell 3) each with a fixed crest weir at 13.6 ft NGVD to limit drawdown of each treatment cell to the desired static water level of 13.6 ft NGVD (maximum combined discharge of 500 cfs). This outfall then enters the Discharge Canal, which gravity discharges to the L-4 borrow canal via six culverts at G607. With the exception of groundwater seepage, the Discharge Canal has no other source water other than STA 6. Upon demand, water can be conveyed from L-4 canal backward (using stop logs at G604 to bypass flows to the L-4 from the G607 culverts) to USSC Unit 2 farm for irrigation. As a consequence, unlike other STAs, timing, quantity, duration of inflows and backflows, and thus mean depth, hydraulic loading rate and hydraulic residence time (HDT) of STA 6 are controlled by USSC via the operation of G600.

In June and August 1999, samples of surface water and mosquitofish were collected at STA 6 using standard operating procedures developed for the Everglades Mercury Screening Program (SFWMD-Hg-SOP10: Mercury in Surface Water, SFWMD-Hg-SOP04: Mercury in Fish and Macroinvertebrates). Briefly, employing clean hands – dirty hands technique, duplicate samples of both filtered and unfiltered surface water were collected using a peristaltic pump and ultra-cleaned Teflon sampling train. Surface water samples were collected from the interior of Cell 5 (site 3), the interior of Cell 3 (site 8), and from the Discharge Canal downstream of G354B culvert from Cell 5 (site 5; **Figure A7-13-1**). Water samples were immediately shipped on blue ice to the Florida Department of Environmental Protection (FDEP) laboratory for determination of unfiltered total mercury (THg) and dissolved methylmercury (MeHgf). Dissolved methylmercury was operationally defined as material passing through a 0.45 µm Meissner capsule filter.

Mosquitofish (*Gambusia spp.*, @ 100 individuals from all size classes) were collected using long-handled dip nets, pooled, homogenized using a Polytron® and treated as a composite sample. Mosquitofish were sampled from both upstream (site 1) and downstream (site 2) of both inflow weirs to Cell 5 and composited to produce an upstream composite sample and a downstream composite sample (**Figure A7-13-1**). Likewise, mosquitofish were collected both upstream (site 6) and downstream (site 7) of the inflow weir to Cell 3. In addition, mosquitofish were collected from the interior of both Cell 5 (site 3) and Cell 3 (site 8). Mosquitofish were also collected both upstream (site 4) and downstream (site 5) of all three culverts discharging from Cell 5 (G354A, G354B, and G354C) and composited. While Cell 3 has three Discharge culverts (G393A, G393B, and G393C), only G393B was discharging. Accordingly, mosquitofish were sampled upstream (site 9) and downstream (site 10) of G393B. Lastly, mosquitofish were also collected one mile downstream from the discharge site into the L4 Canal (site 11). Mosquitofish homogenates were frozen and shipped on blue ice to FDEP as laboratory capacity and opportunity allowed.

In September 1999, sunfish (*Lepomis spp.*) were collected during the permit-mandated annual collection of largemouth bass from the STA. Attempts were made to

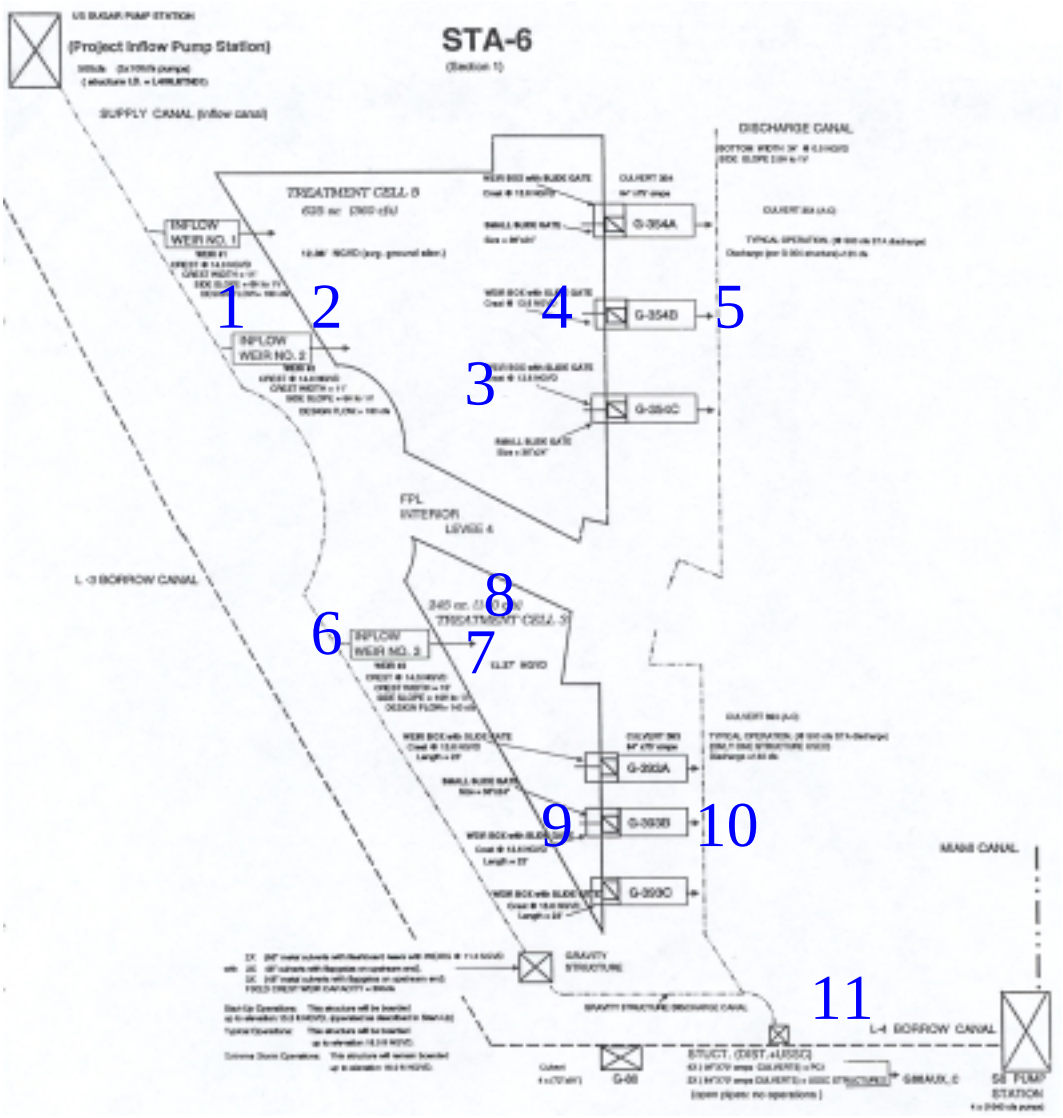

Figure A7-13–1. Map of STA 6 showing collection sites.

collect sunfish using electroshocking methods from four sites: the Supply Canal near the inflow pump (G600; i.e., site 1 **Figure A7-13-1**), Discharge Canal near the outflow (G606; i.e., site 10), interior Cell 5 (site 3) and interior Cell 3 (due north of site 9). Due to access problems, only the eastern portion of Cell 5 was shocked. Similarly, due to access difficulties, Cell 3 was shocked only in open water in the vicinity of the boat ramp. Whole sunfish were then homogenized (i.e., with stomach contents to define exposure to wading birds) using a commercial meat grinder or food processor with stainless steel blades. Homogenates were then shipped to FDEP laboratory for determination of total mercury (THg).

THg analysis was carried out using EPA Method 1631 (EPA-821-R-99-005). In brief, all mercury in the sample was oxidized to Hg(II) using 0.2N bromine monochloride solution. After oxidation, hydroxylamine hydrochloride was added to inhibit further reaction and to destroy free halogens. Hg(II) was reduced to volatile Hg(0) by the addition of stannous chloride. The Hg(0) was then separated from solution by purging with nitrogen and concentration onto a gold-coated sand trap. The trapped Hg was thermally desorbed from the gold trap and determined using cold vapor atomic fluorescence spectroscopy. Following codistillation into pure water, MeHg was determined by aqueous phase ethylation using sodium tetraethyl borate (sodium tetraethyl borate converts nonvolatile monomethyl-Hg to gaseous methylethyl-Hg), followed by purge-and-trap on a Carobotrap™. The trap was then thermally desorbed into an isothermal GC column for peak separation and then quantified by cold vapor atomic fluorescence spectroscopy. THg concentrations in fish tissues were determined using a modified version of EPA Method 245.6. The mercury in the sample was first oxidized to Hg(II) using a combination of potassium permanganate and potassium persulfate. Hydroxylamine hydrochloride was then added to reduce excess oxidizing reagents. The mercuric ions in solution were reduced to Hg(0) using stannous chloride and purged into an atomic absorption spectrometer (Varian SpectraAA 400 with SPS5 autosampler, Mulgrove, Victoria, Australia) using UHP grade nitrogen.

Field quality control samples, which included trip blanks, field blanks and equipment blanks met the requirements of the Quality Assurance Project Plan. Relative percent differences (RPD) between field duplicates for THg concentration in surface water were <25%. With the exception of two high RPDs between duplicates of MeHg (130–171%; associated data were flagged in the table), precision of MeHg in surface water was <13%. Laboratory quality control samples for water included laboratory fortified blanks, matrix spikes, matrix spike duplicates and lab duplicates. Recoveries for lab fortified blanks averaged 102.2% (n=3) for THg and 102.3% (n=5) for MeHg. Mean recovery was 102.2% (n=5) THg during analysis of fish tissues. Matrix spike recoveries in water samples averaged 102% (n=4) for THg and 90.4% (n=4) for MeHg. The matrix spike recovery for THg in mosquitofish was 98.3% (n=8) and for sunfish 97.3% (n=8). RPDs between laboratory duplicates of water were < 12.1% (n=4) for MeHg and <8% (n=3) for THg. The RPD between laboratory duplicates of fish tissues was <17.9% (n=13). Method detection limit was 0.05 ng/L and 0.02 ng/L for THg and MeHg, respectively, in surface water. Method detection limit for THg in fish tissues ranged from 0.094 to 4.2 ng/g for mosquitofish and from 8 to 21 ng/g for sunfish.

RESULTS AND DISCUSSION

SPATIAL PATTERNS

Mercury concentrations in STA 6 surface waters are summarized in **Table A7-13-1**. Concentrations of both THg and MeHgf were within the typical range observed in routine mercury monitoring of STA 6 inflow and outflow, and in surface water collected elsewhere in the Everglades (**Appendix 7-9**). On 29 June 1999, THg concentrations were relatively similar in samples collected from the three sites, whereas MeHgf concentrations were more variable. Lowest concentrations of MeHgf occurred in Cell 3. However, relative percent differences (RPD) in MeHgf concentration between duplicate samples taken both from Cell 3 and the Discharge Canal were unacceptably high (130-171%) and, thus, mean values were suspect.

On 5 August 1999, surface water THg concentrations were greater at all three sites compared to the previous sampling event with increases ranging from 66-215%. Conversely, MeHgf was substantially lower at two of the sites, with maximal MeHgf concentration now occurring in Cell 3. MeHgf as a percent of THg (%MeHg) was variable but always highest in the Discharge Canal.

Table A7-13-1. Mean concentrations of total mercury (THg) and dissolved methylmercury (MeHgf) in surface water collected from STA 6. Values represent mean of duplicate samples.

Collection Date	THg (ng/L)			MeHgf (ng/L)			%MeHg		
	Cell 5	Cell 3	Discharge Canal	Cell 5	Cell 3	Discharge Canal	Cell 5	Cell 3	Discharge Canal
June 29, 1999	1.1	1.0	0.99	0.22	0.14*	0.27*	20%	14%*	27%*
August 5, 1999	1.55	2.15	1.5	0.08	0.18	0.14	5%	8%	9%

* Data suspect due to unacceptably high relative percent difference (RPD) between duplicates (130-171%).

As evident from **Table A7-13-2**, THg concentrations in STA 6 mosquitofish were spatially highly variable, ranging from 22 to 143 ng/g. Mosquitofish from the Supply Canal (sites 1 and 6) contained relative low levels of THg. These levels were similar to concentrations in fish collected just downstream of the inflow weirs (i.e., within the treatment cells - sites 2 and 7). Notice, that mosquitofish from the three sites within Cell 5 contained relatively similar levels of THg. Alternatively, mercury concentration in mosquitofish from the three sites within Cell 3 were highly variable, with highest levels occurring in fish collected immediately upstream of the outflow culvert (site 9). Thus, concentration increased across the cell. Although average THg concentration in mosquitofish from Cell 3 was 2.6 times greater than the average concentration in Cell 5 fish, this difference was not statistically significant (t-test, df=4, t=-1.77, p=0.15). However, detection of statistically significant differences was unlikely given the observed variance in THg concentrations and small sample sizes (n=3).

Unlike mosquitofish upstream and downstream of the inflow weirs, which were very similar, mosquitofish collected from the Discharge Canal did not resemble mosquitofish collected just upstream of the outflow culverts. In the case of Cell 5, mosquitofish in the Discharge Canal downstream of the culvert (site 5) contained 3 times the amount of THg as fish collected just upstream of the culvert (site 4). Alternatively, THg was at lower concentration in mosquitofish from the Discharge Canal collected near the Cell 3 culvert (site 10) compared to fish collected just upstream of the culvert (site 9). Mean concentration of THg in mosquitofish from the Discharge Canal (93.5 ng/g) was similar to the concentration in mosquitofish collected further downstream in the L-4 Canal (site 11), but was over 2 times the level observed in fish from the Supply Canal.

Table A7-13-2. Concentrations of THg in mosquitofish and calculated bioaccumulation factors (BAF; for locations see **Figure A7-13-1**). BAFs were calculated where water and mosquitofish were co-sampled.

Site	Site description	THg (ng/g) Jun./July 1999	BAF	THg (ng/g) August 1999	BAF
1	Supply Canal upstream of Cell 5 inflow weirs	47			
2	Cell 5 downstream of inflow weirs	43			
3	Cell 5 interior	22	1.0×10^5	5	0.62×10^5
4	Cell 5 upstream of discharge culverts	33			
5	Discharge Canal downstream of culverts	100	3.7×10^5	81	5.8×10^5
6	Supply Canal upstream of Cell 3 inflow weir	38			
7	Cell 3 downstream of inflow weir	44			
8	Cell 3 interior	71	5.1×10^5	53	2.9×10^5
9	Cell 3 upstream of discharge culvert	143			
10	Discharge Canal downstream of culvert	87			
11	L4 Borrow Canal	92			

Concentrations of THg in mosquitofish collected in August followed similar spatial patterns as observed in June-July. That is to say that mosquitofish from the Discharge Canal (i.e., downstream of Cell 5 outflow culverts) contained a substantially greater concentration of THg than Cell 3 mosquitofish (i.e., Site 8), which, in turn, contained greater concentration than Cell 5 mosquitofish. This spatial pattern of higher mercury concentrations in fish from the Discharge Canal compared to the interior marsh or the Supply Canal (as shown in the June-July event) was consistent with and confirms patterns observed in the routine mercury monitoring in mosquitofish at this site (**Appendix 7-9**).

The THg concentrations in mosquitofish did not correlate with concentrations of MeHgf measured in the filtered surface water samples (**Figure A7-13-2**). This was not surprising in light of known spatial and temporal variability of THg and MeHg in surface waters. Demonstrating a strong correlation would likely require averaging surface water concentrations monitored over a longer period of time. On the other hand, the differences

observed between THg levels in mosquitofish from Cell 5 and Cell 3 were consistent and directly correlated with observed differences in sediments. As discussed elsewhere (**Appendix 7-9**), sediments cores taken from Cell 3 were found to have greater concentration of both THg and MeHg than cores taken from Cell 5.

Similar to mosquitofish, sunfish from STA 6 showed considerable intra- and inter-site variability in THg (**Figure A7-13-3**), with concentrations ranging from less than 19 ng/g (i.e., below detection limit) to 350 ng/g. While THg in sunfish differed among sites (Kruskal-Wallis test; df =2, H =27.6, p=0.001), median values in Supply Canal (77 ng/g) and Discharge Canal (130 ng/g,) were not significantly different (Dunn's Test, p >0.05). Sunfish also differed among sites with regard to size (ANOVA; df=2,59; F=3.7; p=0.03). Sunfish collected from the Discharge Canal (176 ±33 mm) were larger than fishes collected from Cell 5 (148 ±31; Tukey test, p <0.05), but did not differ significantly in size from Supply Canal fish (162 ±34 mm; p >0.05).

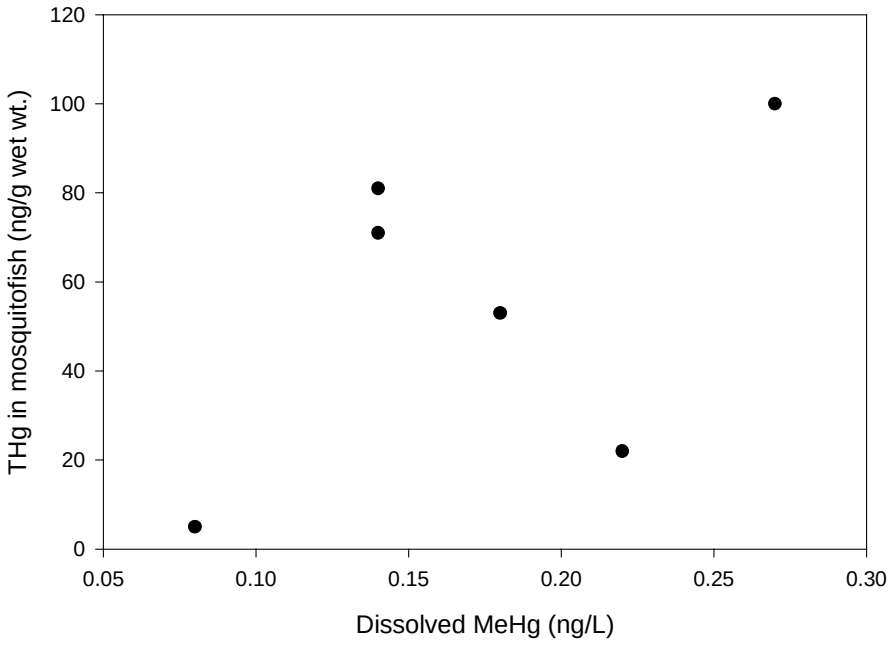

Figure A7-13-2. Relationship between dissolved MeHg in surface water and bioaccumulated mercury in mosquitofish.

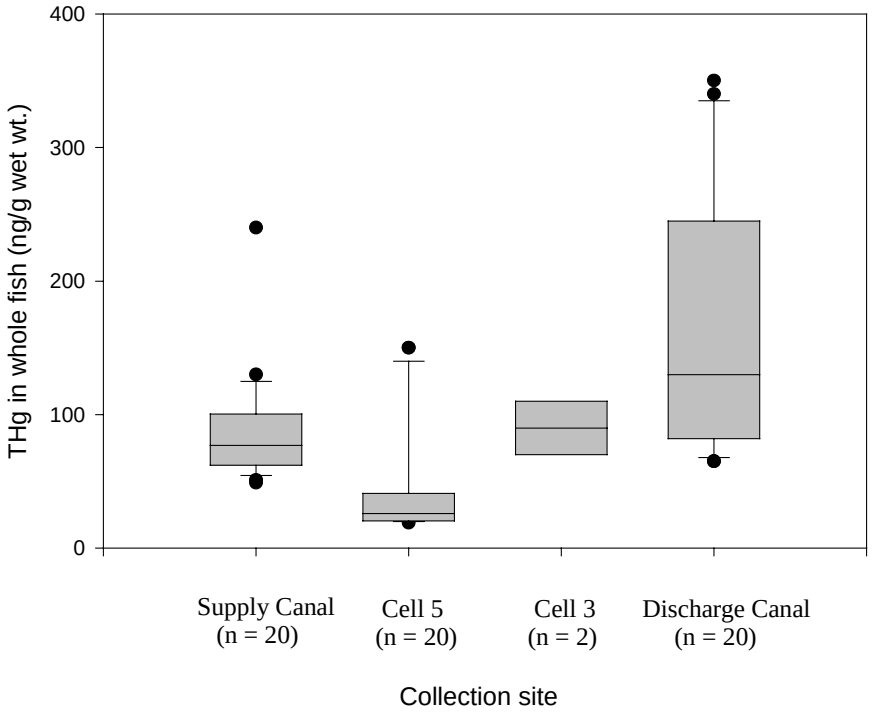

Figure A7-13-3. Boxplots of THg concentrations in sunfish (*Lepomis spp*.) collected at STA 6. Outliers that lie outside the 10th and 90th percentile shown as filled circles.

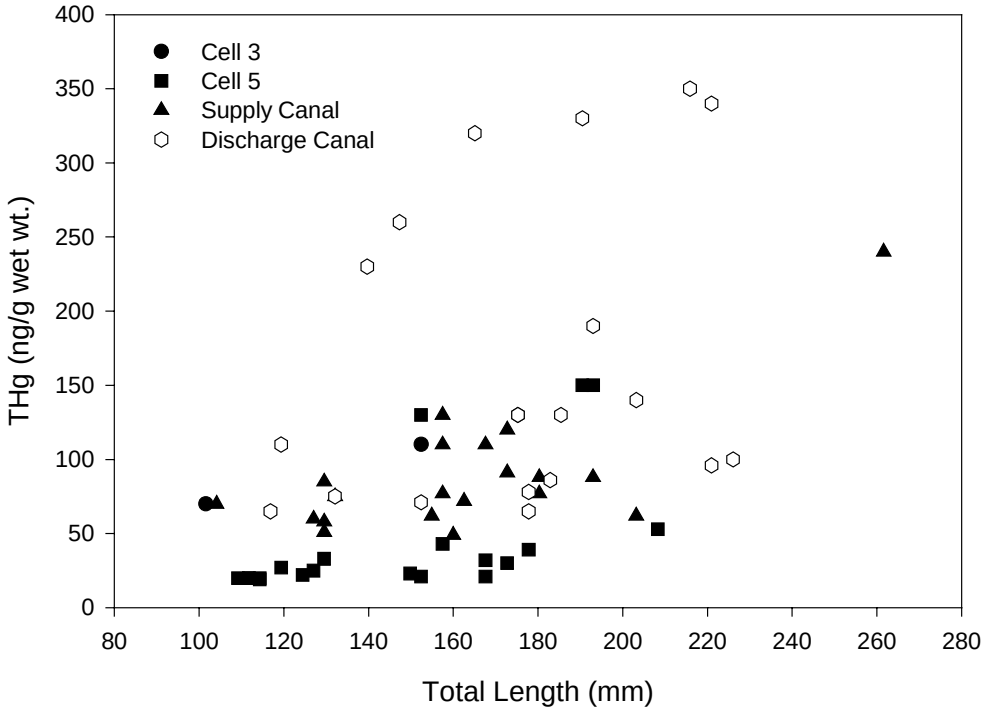

Figure A7-13-4. Relationship between sunfish size and bioaccumulated mercury.

While median values of THg in sunfish did not differ between Supply Canal and Discharge Canal, an analysis of size-concentration relationships (**Figure A7-13-4**) shows elevated mercury concentrations in several fish from the Discharge Canal that were of comparable size to fish collected from the other sites. There were no substantial among-site differences in the species of *Lepomis* collected.

The spatial patterns observed in the sunfish were consistent with results from routine mercury monitoring of largemouth bass at STA 6 that showed greater concentrations in fish from the Discharge Canal relative to the Supply Canal and greater concentrations in Cell 3 fish relative to Cell 5 fish (**Appendix 7-9** of this report).

POTENTIAL FACTORS RESPONSIBLE FOR OBSERVED SPATIAL PATTERNS IN MERCURY

A number of biological, chemical and physical processes are important to mercury cycling. Factors offered to account for the observed spatial patterns in STA 6 mercury cycling center on hydrology, sediment geochemistry, and biology.

Hydrology

Unlike other STAs, the timing, quantity, duration of inflows and backflows, and thus mean depth, hydraulic loading rate and hydraulic residence time (HDT) of STA 6 are controlled by the United States Sugar Corporation (USSC) via its operation of the G600 pump. Under their operation, STA 6 may undergo long periods of standing water or conversely drydown (**Figure A7-13-5**). Low-flow conditions would likely foster methylation of inorganic mercury and ultimately MeHg bioaccumulation. This accumulated MeHg will bioaccumulate in bass and other fish that take refuge in ponded areas. Drydown would most likely alter sediment (and porewater) chemistry, and possibly foster the release of inorganic mercury from soils, which could then be methylated. As will be discussed elsewhere (**Appendix 7-8**), drydown and subsequent exposure and oxidation of sediments in the WCAs have been found to significantly influence mercury biogeochemistry resulting in increased surface water concentration of MeHg (for possible export) and increased bioaccumulation.

While average ground elevation is reportedly similar in Cell 5 and Cell 3 (i.e., 12.38 and 12.37 ft, respectively; SFWMD, 1997), significant between-cell differences in topography can be observed during flyovers of STA 6. For example, Cell 5 has what appears to be a natural slough running through its center, whereas Cell 3 contains a borrow canal along its northern boundary. Hydrologic differences likely account for observed between-cell differences in vegetation types (Cell 5 is dominated by miscellaneous grasses, where as, Cell 3 is dominated by sawgrass, willow and a mixture of shrubs; for details see vegetation map produced on 24 August 1998 by Geonex Corporation for SFWMD).

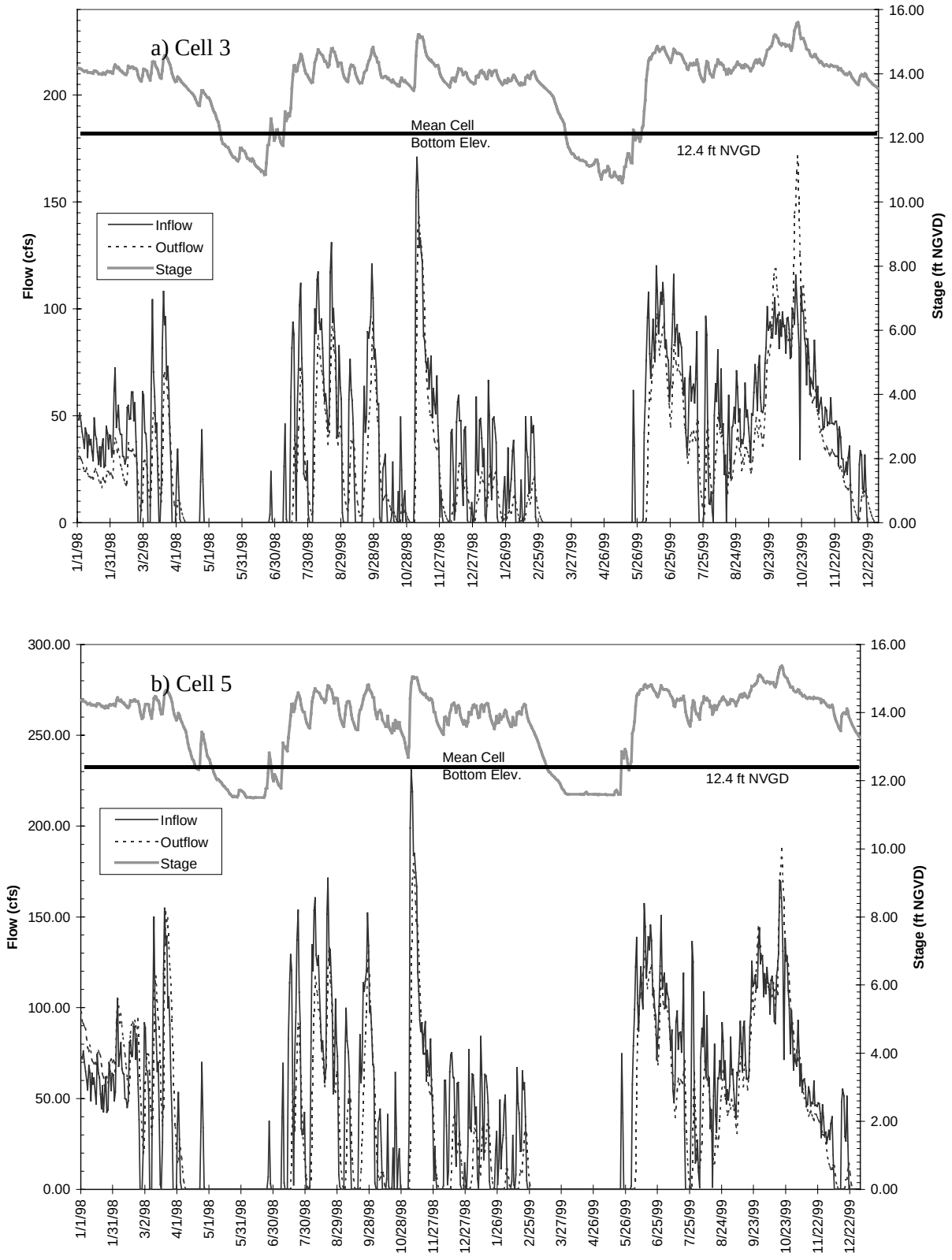

Figure A7-13-5. Stage and flow data for STA 6 (from Huebner, in prep).

Substantial between-cell differences in mean depth or areal extent of drydown, if they occur, might account for observed spatial patterns in mercury. However, without additional follow-up studies in ponded areas or immediately pre- and post-drydown, these theories remain speculative.

Sediment Geochemistry

Sediment and porewater chemistries are critical factors influencing rates of *in situ* methylation (Gilmour et al., 1998). As mentioned in the preceding section, drydowns have been found to alter sediment and porewater chemistry in the WCAs. However, it is difficult to predict what will occur in STA 6 sediments under drydown conditions because the dominant soil types, Plantation muck and Margate sand, are considered "Everglades Rim" type soils and may not behave like WCA soils. Routine monitoring of STA soil pore water chemistry is not required in either the state of federal permits, so the quantification of these pre- and post-dryout influential factors has not occurred. Likewise, a voluntary (i.e., non-mandated) study to investigate mercury release rates from these soil types that was scheduled to occur in 1999-2000 was postponed due to budgetary constraints.

The importance of sediment chemistry in explaining spatial patterns in mercury cycling in STA 6 was underscored by an observed between-cell difference in both sediment-THg and –MeHg. Sediment concentrations of both THg and MeHg were greater in cores (collected both in 1997, prior to flooding, and in 2000) from Cell 3 as compared to Cell 5 (**Appendix 7-9**). Thus, this between-cell difference in sediment, which may account for observed between-cell differences in MeHg bioaccumulation in fish, was likely present prior to the District taking over operation of the STA. It should also be noted that 1) concentrations of THg and MeHg in sediment cores taken at STA 6 both in 1997 and in 2000 were well within the expected range for Everglades soils, and 2) concentrations did not differ significantly between years in either THg or MeHg concentration (for analysis, refer to **Appendix 7-9**).

Biology

Although bioaccumulation factors (BAFs) and biomagnification factors (BMF, or predator-prey factors) are gross over-simplifications of the real world situation, they provide another means by which to evaluate mercury-monitoring data. While spatially and temporally variable, calculated BAFs for the mosquitofish (**Table A7-13-2**) were up to 2 times larger than BAFs calculated for mosquitofish at WCA 2A-F1 or WCA 2A – U3 (**Appendix 7-9**). Calculated BAFs for sunfish (i.e., based on mean concentration of MeHg in unfiltered surface water samples collected during previous four quarters of routine monitoring) were 4.24×10^5 and 1.58×10^6 in fish from the Supply Canal and Discharge Canal, respectively. The latter was relatively large compared to similar estimates for sunfish collected elsewhere in the Everglades (**Appendix 7-9**). Alternatively, BMFs calculated for sunfish (i.e., ratio of tissue concentration in sunfish to mosquitofish collected during previous two semi-annual events of routine monitoring) from these sites (BMFs of 3, 7 and 4: Supply Canal, Cell 5, and Discharge Canal, respectively) were within typical ranges observed elsewhere in the Everglades (**Appendix 7-9**).

The unusually large BAFs for mosquitofish and sunfish reported here from the Discharge Canal, in combination with large BAFs previously reported for largemouth bass from the STA 6 Discharge Canal (1.76×10^6 from Supply Canal and 5.64×10^6 from Discharge Canal; **Appendix 7-9**) suggest that concentration of MeHg in the water column does not solely account for the observed spatial patterns in bioaccumulation. Observed patterns in BMFs reported here for sunfish and previously reported for largemouth bass (11.9 for Supply Canal and 13.8 for Discharge Canal, **Appendix 7-9**) suggest that food habits may differ across the STA.

There has been some speculation that sampled largemouth bass populations may not be representative of STA 6 conditions. Specifically, it has been theorized that bass could move large distances and confound spatial interpretations. If there were no resident population of largemouth bass in STA 6, due to drydowns, then fish collected from the interior marsh and Discharge Canal of STA 6 would not be representative of the mercury influence of STA 6. Instead sampled populations would represent a commingling of resident populations from the L-3 and L-4 canals. The results reported here for mosquitofish and sunfish, which confirm the spatial patterns observed in largemouth bass, weakens this theory, because mosquitofish and sunfish species are not expected to range over such large distances.

ENVIRONMENTAL SIGNIFICANCE

While it would be informative to determine the factors that produced these spatial patterns in mercury, it is more important that export of THg and MeHg, and MeHg bioaccumulation in STA 6 fish be placed into proper perspective and assessed in terms of their environmental significance. As reported in this appendix and **Appendix 7-9**, surface water concentrations of both THg and MeHg did not vary outside the normal range observed in the District's primary canals. Moreover, measured values of THg in STA 6 surface waters never exceeded the Florida Class III Water Quality Standard of 12 ng THg/L. Nevertheless, surface water concentrations observed during this follow-up study and during past routine monitoring have shown periods of MeHg export. Although a mass budget has not been done for mercury at STA 6, owing to the uncertainties introduced by hydrologic complexities (e.g., back-pumping by USSC; for review see **Appendix 7-9**), quarterly sampling and distance to the nearest mercury deposition network (MDN) station, exported loads from STA 6 are believed to be minor (i.e., when these concentration differences are combined with estimates of surface water discharge; **Figure A7-13-5**; also see Huebner, in prep). At this point, it should also be reiterated that operational monitoring of STA 6 surface waters over the last six quarters has shown both THg and MeHg to be lower or at the same concentration at the outflow as compared to the inflow (i.e., no net export; **Appendix 7-9**).

Mean concentration of THg in mosquitofish and sunfish collected from STA 6 during this follow-up study were 61 ±36 ng/g and 99 ±82 ng/g, respectively (median concentrations were 50 ng/g for mosquitofish and 76 ng/g for sunfish). These concentrations were higher than concentrations generally observed in fish from the ENR Project, but were lower than or similar to levels in fish collected from the northern portions of the Water Conservation Areas (Appendices 7-9A and 7-14A this report). These tissue concentrations can also be put into perspective and evaluated with regard to

mercury risk to wildlife. The U.S. Fish and Wildlife Service (USFWS) has proposed a predator protection criterion of 100 ng/g THg in prey species (Eisler, 1987). More recently, in its Mercury Study Report to Congress, USEPA proposed 77 ng/g and 346 ng/g for trophic level (TL) 3 and 4 fish, respectively, for the protection of piscivorous avian and mammalian wildlife (USEPA, 1997). Average concentration of THg reported here for mosquitofish, which are considered to be at TL 2-3 depending on age (Loftus et al., 1998) was below both agencies' wildlife criteria. Again using mean concentration as a guide, STA 6 sunfish (TL 3-4; Loftus et al., 1998) were near the USFWS' predator protection criterion but slightly above USEPA's guidance criterion for TL 3 fish. Likewise, after adjusting fillet concentration to whole-body concentration (whole-body THg concentration = 0.69 x fillet THg; Lange et al., 1998), mean concentration of THg in largemouth bass (a TL 5 fish; Loftus et al., 1998) from STA 6 was 275 ng/g (for data see **Appendix 7-9**), and, thus, was below USEPA's guidance criterion for TL 4 fish.

MAJOR FINDINGS

In conclusion, this follow-up study confirms results from routine mercury monitoring at STA 6. Key findings are as follows:

1. Concentrations of both THg and MeHgf were within the typical range observed in routine mercury monitoring of STA 6 inflow and outflow, and in surface water collected elsewhere in the Everglades.

2. THg concentrations in STA 6 mosquitofish were spatially highly variable, with higher concentrations in Cell 3 mosquitofish compared Cell 5 and, more importantly, higher concentrations in Discharge Canal mosquitofish compared to Supply Canal mosquitofish. Calculated BAFs for the mosquitofish were higher than BAFs calculated for mosquitofish collected elsewhere in the Everglades.

3. THg concentrations in sunfish from STA 6 also showed considerable intra- and inter-site variability. Like mosquitofish, sunfish from the Discharge Canal contained greater THg concentrations than sunfish from the Supply Canal; however, these differences were not statistically significant. Sunfish from the Discharge Canal had a relatively large BAF compared to sunfish collected elsewhere in the Everglades.

4. While the underlying mechanism(s) responsible for these spatial patterns in mercury has not yet been conclusively identified, measured concentrations in sediment, surface water and fish from STA 6 currently do not appear to present a substantial environmental impact to local wildlife or to the downstream watershed.

LITERATURE CITED

Eisler, R. 1987. Mercury hazards to fish, wildlife, and invertebrates: a synoptic review. Biological Report 85 (1.10). Contaminant Hazard Review Report No. 10. U.S. Department of the Interior, U.S. Fish and Wildlife Services. Laurel, MD.

Gilmour, C.C., G.S. Ridel, M.C. Ederington, J.T. Bell, J.M. Benoit, G.A. Gill and M.C. Stordal. 1998. Methylmercury concentrations and production rates across a trophic gradient in the northern Everglades. Biogeochemistry. 40: 327-345.

Huebner, R.S. in prep. Water budget analysis for Stormwater Treatment Area 6, Section 1. Technical Memoradum. South Florida Water Management District, West Palm Beach, FL.

Lange, T.R., D.A. Richard, and H.E. Royals. 1998. Trophic Relationships of Mercury Bioaccumulation in Fish From the Florida Everglades. Annual Report. Florida Game and Fresh Water Fish Commission, Fisheries Research Laboratory, Eustis, FL. Prepared for the Florida Department of Environmental Protection, Tallahassee, FL. August.

Loftus, W.F., J.C. Trexler, and R.D. Jones. 1998. Mercury transfer through Everglades aquatic food web. Final report to the Florida Department of Environmental Protection. Tallahassee, FL. December 1998.

Rumbold, D.G., and P. Rawlik. 2000. Annual permit compliance monitoring report for mercury in stormwater treatment areas and downstream receiving waters. Appendix 7-2 in Everglades Consolidated Report 2000. South Florida Water Management District, West Palm Beach, FL. January.

SFWMD. 1997. Operation plan: Stormwater Treatment Area No. 6, Section 1. South Florida Water Management District, West Palm Beach, FL.

USEPA. 1997. Mercury study report to Congress. Vol. VI: An ecological assessment for anthropogenic mercury emissions in the United States. EPA-452/R-97-008.