TOC Briefing on STA-2 Mercury Anomaly

by

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Acknowledgements

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- Special thanks to Sharon Niemczyk, whose dedication and attention to detail made all the difference. We wish her well in her new job with FDEP.

TOC Briefing on STA-2 Mercury Anomaly

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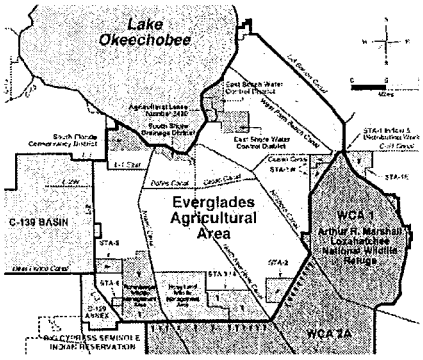
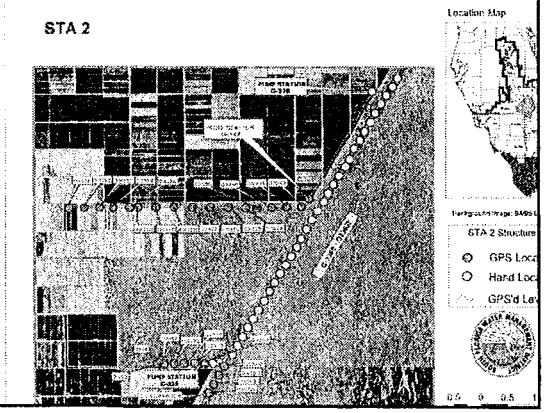
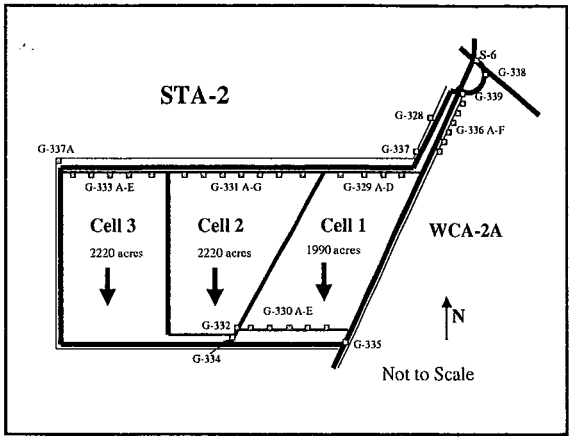
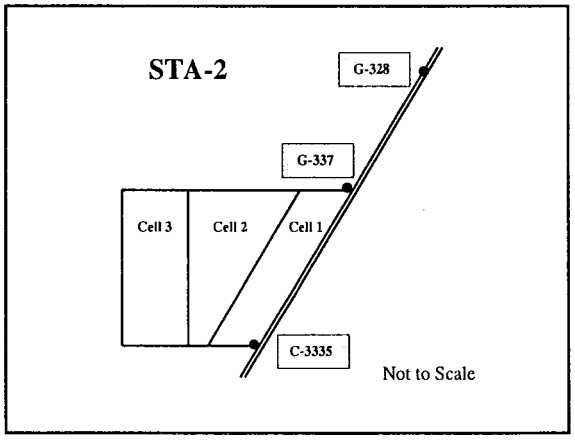
STA-2 Start-Up Mercury Studies

Part 1:Background Information









STA-2 Permit Mercury Conditions

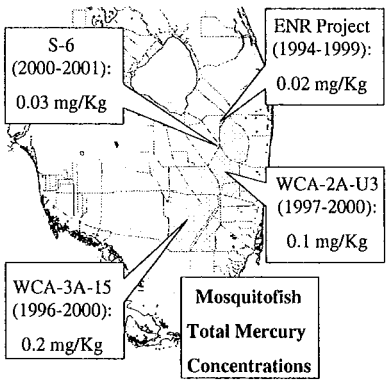
- Stormwater Treatment Areas (STAs) created by flooding former farmland or drained remnant Everglades.
- FDEP/USEPA concerned about transient "first-flush" of inorganic mercury, Hg(II), and subsequent transient "first-flush" production of methylmercury following flooding.
- Also concerned about long-term "reservoir effect."

STA-2 Permit Mercury Conditions

- Florida/Federal STA permits require biweekly mercury monitoring during pre-op. start-up.
- Unfiltered total mercury (U-THg) and methylmercury (U-MeHg) at inflow and representative interior site.
- When interior not significantly greater than inflow for U-THg and U-MeHg, discharge may commence.
- Begins stabilization period during which outflow concentrations can be greater than inflow.

STA-2 Permit Mercury Conditions

- Florida/Federal STA permits also require reporting anomalous mercury conditions during start-up or routine operation.
- Anomalous mercury condition is defined relative to Everglades Nutrient Removal (ENR) Project.
- Of all Everglades sites, ENR Project had lowest interior and outflow THg and MeHg in water; and
- … lowest THg concentrations in mosquitofish, sunfish, and largemouth bass.



STA-2 Start-Up Mercury Studies

Part 2: Summary of Anomalous Mercury Event

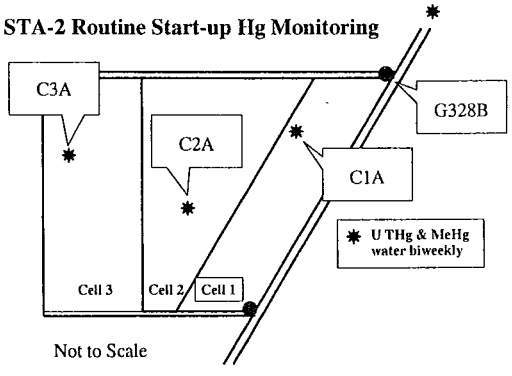
STA-2 Mercury Status Summary

- STA-2 construction began Jan '98.
- Each cell can be operated independently.
- Cell 3 former farm land; Cell 2 primarily and Cell 1 all remnant Everglades wildlife area.
- Soil elevation decreases in order Cells 1, 2, and 3.
- Cells 2 and 3 dewatering water pumped to Cell 1.
- Cell 1 dewatering water pumped to Cell 2.
- Start-up monitoring began Jul 20, '00.

STA-2 Mercury Status Summary

- Cells 3 and 2 met mercury start-up criteria on Sep 14 and Nov 9, '00, respectively.
- Cell 1 water methylmercury anomaly observed on Sep 28 '00.
- FDEP directed District to conduct 90-day follow-up study of water, sediment, and mosquitofish.

STA-2 Routine Start-up Hg Monitoring



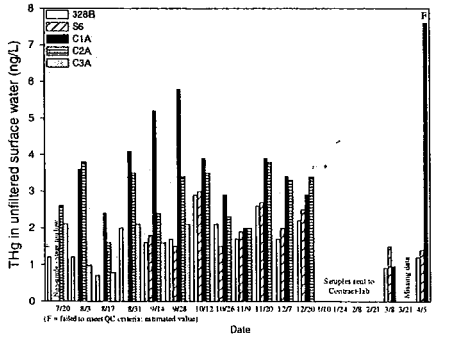


Fig. 2. Total mercury concentrations in surface water collected at STA-2 during start up (FDEP laboratory).

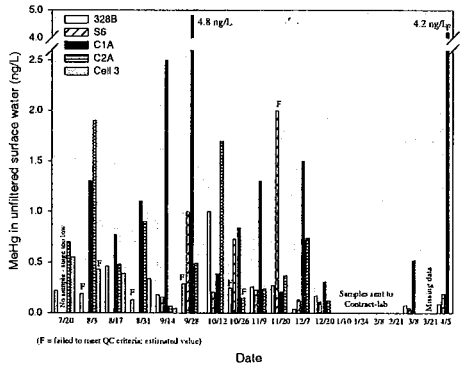
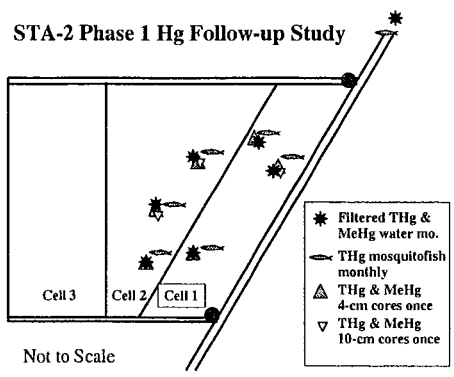
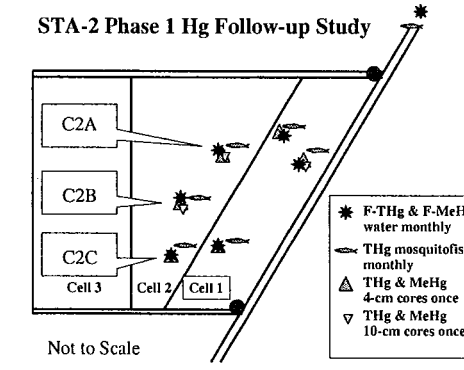
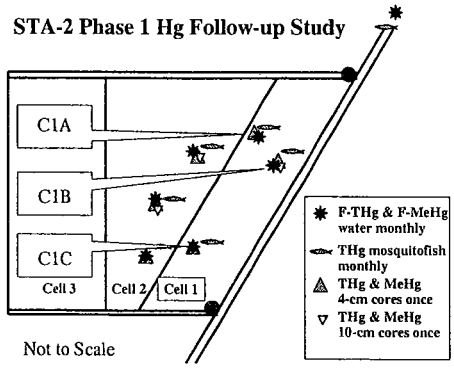


Fig. 3. Methylmercury concentrations in surface water during STA-2 start-up (FDEP laboratory).







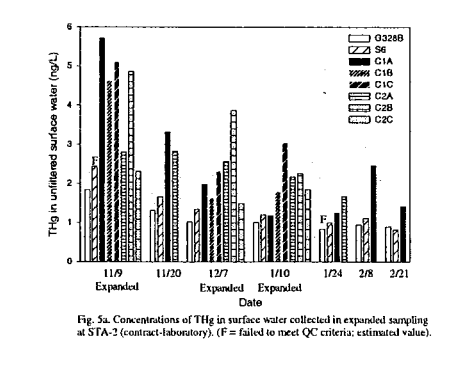


Fig. 5a. Concentrations of THg in surface water collected in expanded sampling at STA-2 (contract-laboratory). (F = failed to meet QC criteria; estimated value).

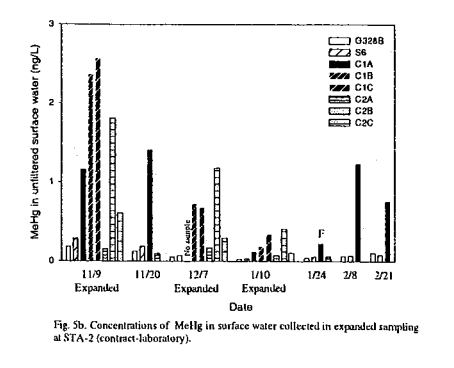


Fig. 5b. Concentrations of MeHg in surface water collected in expanded sampling at STA-2 (contract-laboratory).

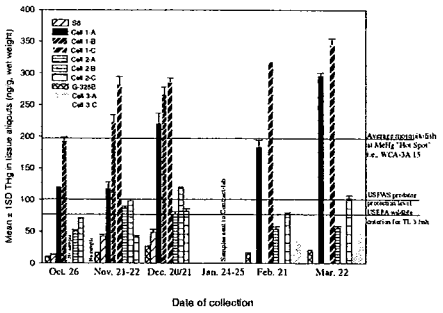
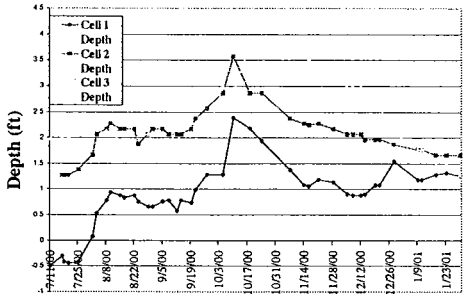


Fig. 10. Results of expanded start-up sampling at STA-2: mosquitofish (FDEP Laboratory).

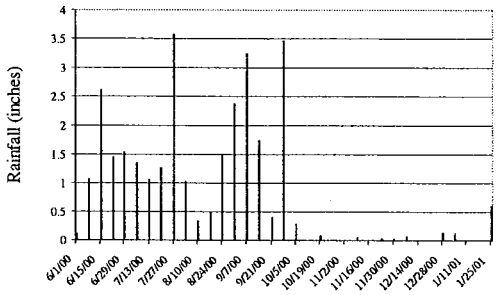
Why Cell 1 > Cell 2?

- Cell 1 received dewater from other cells.
- Cell 1 has a higher average elevation than Cell 2 and likely dried out more than Cell 2 prior to and during construction.
- Cell 1 was dry in July '00 just before onset of heavy summer rains.
- In USGS/SFWMD "Post-Burn Study", post-dryout reflooding caused up to 35-fold higher than ave. MeHg levels in soils and pore water at several sites.

STA-2 Water Depth History



Weekly Accumulated Rainfall at S-7 Pump Station



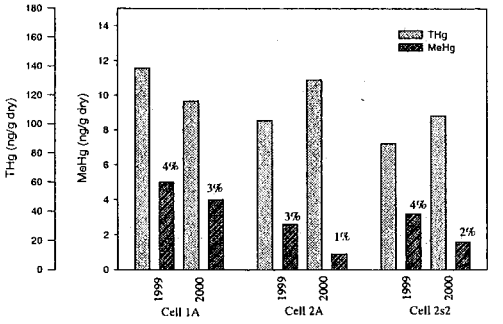
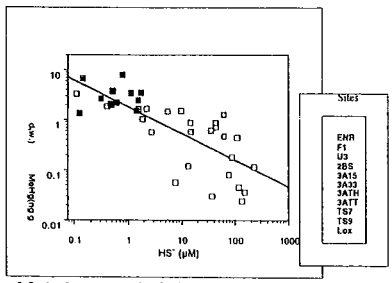


Fig. 7. THg and MeHg concentrations in 10-cm sediment cores collected from STA-2 in 1999 and 2000. Note, two different scales on y-axis. MeHg as a percent of THg in sediment (%MeHg) is also noted for each core.



Methylmercury in Soil vs Pore Water Sulfide

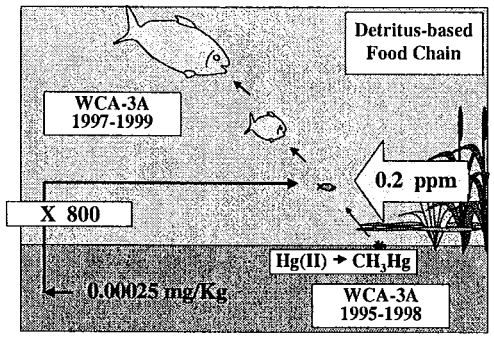
Reproduced from Gilmour et al. (1998b)

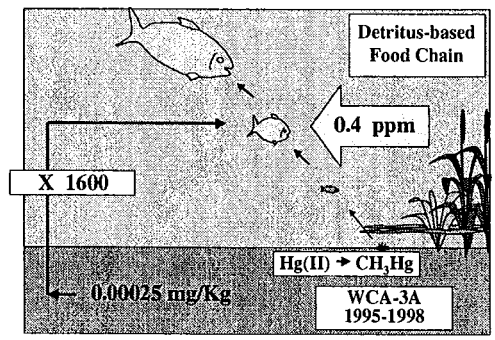
STA-2 Start-Up Mercury Studies

Part 3: Assessment of Ecological Risks

Putting Cell 1 Methylmercury Risks into Perspective

- Cell 1 is similar to WCA-3A-15, the Everglades methylmercury "hot spot"
- Soil methylmercury averages ~ 5% of total.
- Soil bioaccumulation factor for mosquitofish is about 660 vs 800 for 3A-15.
- Mosquitofish >> 3A-15 ave. of 200 ug/Kg wet wt.
- Methylmercury pulse will move up food chain.
- Can use 3A-15 probabilistic ecological risk assessment by Rumbold et al. (2000) for Cell 1.





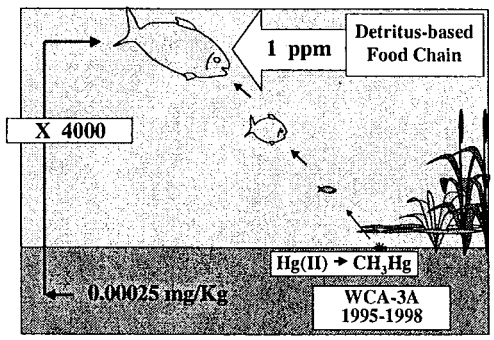


Table 2. Biomagnification factors (BMF) observed at downstream interior marsh sites (adapted from Rumbold et al. 2001).

Location	Mosquitofish to Sunfish		Mosquitofish to Bass EHg(3)		Sunfish to Bass EHg(3)	
	1998	1999	1998	1999	1998	1999
LOX4	3	0.9	9	3	3	3
L39F1	NA	0.6	NA	3	NA	4
L38F1	NA	0.4	NA	2	3	4
Holey Land	1	0.3	9	2	7	6
CA2U3	2	0.5	10	2	5	4
L5F1	1	0.4	3	NA	5	NA
CA3F1	7	0.9	NA	5	NA	5
CA315	3	1.3	NA	4	NA	3
CA3F2	4	1.2	NA	NA	NA	NA
P33	6	2.0	NA	NA	NA	NA
L67F1	NA	2.7	NA	NA	3	NA
Mean	3	1	8	3	4	4

Everglades Ecological Risk Benchmarks

	WCA-2A-U3						WCA-3A-15				
	NOAEL [1]			LOAEL [2]			NOAEL			LOAEL	
	50th	95th		50th	95th		50th	95th		50th	95th
Great Blue Heron	1.03	1.6		0.3	0.5		3.2	4.9		1.1	1.6
Great Egret	0.95	1.4		0.3	0.5		3.9	6.4		1.3	2.2
Wood Stork	0.89	1.2		0.3	0.4		2.4	4		0.8	1.3

(1) No Observable Adverse Effect Level est. from mallard duck NOAEL of 26 ug/kg bw-d from Heinz (1979)
(2) Lowest Observable Adverse Effect Level est. from mallard duck LOAEL of 78 ug/kg-day from Heinz (1979).

STA-2 Start-Up Mercury Studies

Part 4: Conclusions

Conclusions

- Cell 1 risks to fish-eating wildlife not immediate threat but could adversely affect highly exposed, highly sensitive individuals if condition persists.
- Dryout and rewetting likely to put Cell 1 on same mercury trajectory as before.
- Holding wet-season rainwater could exacerbate anomaly.
- Initiating flow-through operation more likely to decrease than increase methylmercury production and bioaccumulation, but converse could occur.