A Baseline Water Quality Assessment of the Kutari and Sipaliwini Rivers

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Chapter 1

A baseline water quality assessment of the Kutari and Sipaliwini Rivers

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SUMMARY

We sampled water quality at 23 sites on the Kutari, Sipaliwini, and Aramatau Rivers. The oxygen content and pH of the Kutari River were lower than those of the Sipaliwini River, probably due to the lack of rapids and the input of organic material from the surrounding forest, particularly after heavy rains, which occurred frequently at the Kutari site. All sites had clear water except the Wioemi Creek, which was very turbid. The parameters measured in the field revealed undisturbed river ecosystems with few negative human impacts. However, high mercury levels were found in both sediment and piscivorous fishes from all sites. Further research is needed to clarify the origin of mercury in the rivers of southwest Suriname. Suggestions are given for a water quality monitoring program that can be implemented by the residents of Kwamalasamutu.

INTRODUCTION

Water is important for all living creatures. The type and quality of water determines which organisms will be found in certain habitats. Assessment of water quality is needed to identify species-habitat relationships and possible sources of pollution or disturbance within the ecosystem. For this reason, it is necessary to gather baseline data on basic environmental parameters (pH, dissolved oxygen, conductivity, turbidity) as well as levels of nutrients (as indicators of nutrient cycling in the surrounding ecosystem) and metals (as indicators of pollution or erosion from underlying bedrock).

Human disturbance was not expected in the area assessed by the Kwamalasamutu RAP survey, but previous studies have discovered mercury pollution in otherwise pristine areas of Suriname. It has been hypothesized that mercury might be transported by the northeast trade winds from gold mining sites in eastern Suriname to the southwestern region of the country (Landburg 2005, P.E. Ouboter *unpubl. data*), or, alternatively, that mountain ranges in central Suriname serve as a barrier, resulting in mercury deposition on the windward side of the mountain ranges and no deposition on the leeward side. A primary goal of this study was to provide baseline information on mercury levels in southwest Suriname to further evaluate these hypotheses.

STUDY SITES AND METHODS

Twenty-three sites were sampled intensively in three major areas: the Kutari River, and two areas of the Sipaliwini River (Fig. 1). The Kutari River can be characterized as a clear water river without major rapids at the time of sampling. The river extends into the forest when the water level increases, resulting in major floodplains in the area. Big creeks flowing into the Kutari River have steep banks and smaller floodplains. The two sampled areas of the Sipaliwini

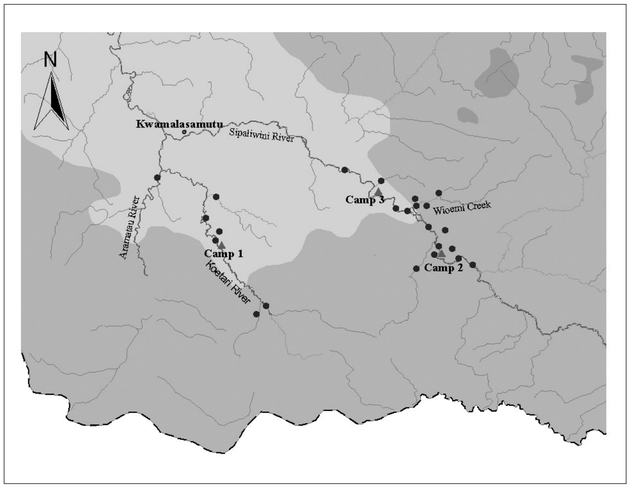

Figure 1. Sites sampled in the Kutari River and two areas of the Sipaliwini River.

River share many characteristics including steep riverbanks, clear water, and much turbulence in the water, caused by the many rapids in the river. The Wioemi Creek is a large creek with especially turbid water, fairly steep banks, a strong current, and moderately extensive floodplains. Other creeks flowing into the Sipaliwini River are clear water streams, with steep banks and weak currents. We also sampled one site near the mouth of the Aramatau River, which was similar to the Kutari River but had steeper banks.

We measured 13 physico-chemical parameters at each site: pH, dissolved oxygen, conductivity, temperature, alkalinity, total hardness, total phosphate, nitrate, chloride, tannin & lignin, ammonia, turbidity, and secci depth (Appendix A). Both titrimetric and colorimetric methods were used to assess the parameters. At selected sites, water samples were saved for later analysis of mercury, iron, and aluminum at the University of Suriname in Paramaribo (Appendix B). For mercury analyses, sediment and fish tissue samples were taken opportunistically. All stored samples were kept under refrigeration in the field.

RESULTS

Summary data on baseline parameters for each site are presented in Appendix A. Measurements of nutrients, salts, and metals from each site are presented in Appendix B.

Kutari and Aramatau Rivers. The oxygen content in the Kutari River and tributary creeks was lower than the other sites (4.2–5.4 mg/L), probably a result of the lack of rapids and the input of organic material from the land. The pH was lower at these sites as well (range 5.6–5.9). Nutrient input comes mainly from the land, as evidenced by the higher nutrient levels measured in the water after heavy rain (phosphate: 0.03–0.1 mg/L; ammonia: 0.26–0.72 mg/L). High levels of mercury were found in both sediment (0.26–0.28 µg/g) and piscivorous fishes (0.05–0.98 µg /g). These levels are higher than the Canadian Interim Sediment Quality Guideline for Protection of Aquatic Life of 0.17µg/g soil, and the European Union standard for human consumption of 0.5 µg/g fish (Canadian Council of Ministers of the Environment 1999; EC 2002).

From the one site sampled in the Aramatau River, low levels of nutrients were measured (phosphate 0.04 mg/L; nitrate: 0.00 mg/L) except for ammonia (average: 0.43 mg/L). The water at this site was found to be very soft (hardness: 0.35 mg/L). High mercury levels were found in the sediment (average: 0.19 µg/g).

Sipaliwini River. At the sites in the Sipaliwini river and tributary creeks, high nutrient levels were measured (phosphate: 0.045–0.145 mg/L; ammonia: 0.51 mg/L average). We also found high levels of iron (0.98–1.29 mg/L). Mercury levels were low in water (0.03–0.07 µg/L) compared to the EPA drinking water standard of 2 µg/L (US EPA 1994), whereas sediment and fish contained higher mercury levels (sediment: 0.12–0.19 µg/g; fish: 0.28–1.17 µg/g).

Wioemi Creek. The strong current and consequent erosion of the steep banks at the time of sampling probably contributed to high turbidity (average turbidity: 22.08 NTU) and nutrient loads (average nitrate: 0.013 mg/L; average phosphorus: 0.105 mg/L; average ammonium: 0.85 mg/L), as well as high levels of aluminum (0.89–1.12 mg/L) and iron (1.56–1.73 mg/L). Mercury levels in the water were low (0.00–0.03 µg/L), while mercury levels in sediment were high (0.18–0.25 µg/g).

DISCUSSION AND CONCLUSIONS

In general, our data revealed river ecosystems with relatively clear water (except Wioemi Creek), high nutrient loads from the surrounding flooded forests, and high levels of metals. High levels of iron and aluminum are usually attributed to natural erosion of the bedrock or anthropogenic activities. Because the area sampled is largely free of large-scale anthropogenic disturbance, the levels of these metals are probably a natural consequence of eroded bedrock material entering the aquatic system.

The high mercury levels found in the ecosystem suggest that small-scale gold mining in eastern Suriname is affecting this area. We know of no gold mining activities in the Kwamalasamutu region, though some residents of Kwamalasamutu expressed concern about gold mining upstream of the Aramatau River. This needs further investigation. The high mercury levels measured in the other rivers indicate that mercury is probably transported through the atmosphere and is being deposited in these systems. Further research is needed to confirm this. Deposition of mercury in these areas may result in accumulation of mercury in the food chain, causing health concerns for residents of Kwamalasamutu.

RECOMMENDATIONS

Because the assessed area is very important for the residents of Kwamalasamutu, it is essential to measure some water quality parameters (as indicators) regularly. Parameters selected need to indicate pollution sources and the safety of drinking water. The monitoring may start with regular measurements of pH, dissolved oxygen, conductivity, temperature, turbidity and/or secci depth, and bacteria (*Escherichia coli*). These measurements should be done every three months. More extensive sampling should be done twice per year — once in the dry season (September–November) and once in the wet season (May–August) — and should include assessments of mercury in river sediments and fishes.

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Appendix A. Water Quality Data – Basic Parameters. Legend: Cond = conductivity; DO = dissolved oxygen; Secci = maximum depth at which markings on Secci disc could be read.

Location	Location name	Cond (μS/cm)	pH	DO (mg/L)	DO (%)	Alkalinity (mg/L $CaCO_3$)	Hardness (mg/L $CaCO_3$)	Tannin Lignin (mg/L)	Turbidity (NTU)	Secci (cm)
01-01	Big creek downstream Koetari river	14.4	6.415	6.25		7.25		1.3	13.25	current too strong
01-02	Koetari river downstream camp 1a	11.4	5.625	5.15		4.85		1.1	9.425	current too strong
01-03	Creek downstream camp 1	10.6	5.785	4.5		3.4	2.85	1	10.01	56.75
01-04	Creek upstream camp 1	11.2	5.805	4.2		6.45	2.35	1.05	6.835	83.75
01-05	Koetari river upstream camp 1	11.4	5.725	5.2		5.6	1.25	1.05	7.39	current too strong
01-06	Koetari river downstream camp 1	11.9	5.87	5.4		5.5	1.3	1.15	8.82	current too strong
01-07	Aramatau river downstream	12.2	6.23	6.5		5.7	0.35	1.05	4.615	1.2
02-01	Sipaliwini river Upstream camp 2	20.6	6.775	7.1	90	8.1	1.95	1.05	0.535	0.535
02-02	Creek upstream camp 2	16.9	6.58	6.85	84.5	7.35	1.85	0.65	1.055	110
02-03	Sipaliwini river upstream camp 2	21	6.655	7.2	92	9.3	2	1.15	4.275	current too strong
02-04	Sipaliwini river downstream camp 2a	21.3	6.545	7.7	98.5	8.9	2.6	0.95	1.15	current too strong
02-05	Creek downstream camp 2 (a)	15.45	5.725	6.3	76	7.05	1.65	1	3.75	77.5
02-06	Creek downstream camp 2 (b)	18.2	6.175	6.75	82.5	8.35	2.4	1.4	0.01	0.01
02-07	Sipaliwini river downstream camp 2	21.4		7.1	91	8.55	2.35	0.85	4.99	current too strong
02-08	creek downstream camp 2	20		6.6	82	9.75	2.25	0.85	0	90
03-01	Sipaliwini river upstream camp 3 (a)	21.4	6.905	7.1	90	8.9	2.8	0.85	5.21	current too strong
03-02	Sipaliwini river-upstream camp 3	22.2	6.42	6.85	87	8.45	2.65	1.25	5.79	66.25
03-03	Creek downstream camp 3	20	6.31	6.6	80	8.85	4.6	1.3	6.695	66.25
03-04	Sipaliwini river downstream camp 3	21.8	6.79	6.7	85	10.4	3.4	0.95	10.9	current too strong
03-05	Creek Wioemi midstream	21.7	5.695	2.7	33	8.75	2.25	0.85	8.855	67.5
03-06	Creek Wioemi upstream	22.9	6.29	6.35	78.5	10.65	2.4	1.1	20.55	40
03-07	Creek Wioemi downstream (a)	22.7	6.2	5.9	73	10.4	2.45	1.15	23.6	45
03-08	Creek Wioemi downstream (b)	16.5	5.76	5.6	72	9.55	2.2	0.85		97.5

Appendix B. Water Quality Data – Nutrients, Salts and Metals.

Location	Location name	PO_4 (mg/L)	NO_3 (mg/L)	Ammonia (mg/L)	Chloride (mg/L)	Aluminium (mg/L)	Iron (mg/L)	Hg in water (mg/L)	Hg in sediment (μg/g)	Hg in fish (μg/g) Average per site
01-01	Big creek downstream Koetari river	0.1	0.01	1	2.5		0.37	0.03		
01-02	Koetari river downstream camp 1a	0.045	0.035	0.72	2.85		1.17	0.03	0.28	
01-03	Creek downstream camp 1	0.06	0.045	0.415	3.7					
01-04	Creek upstream camp 1	0.015	0.02	0.26	4.8					
01-05	Koetari river upstream camp 1	0.03	0.01	0.315	4.6		1.09	0.02	0.26	0.58
01-06	Koetari river downstream camp 1	0.075	0.005	0.7	3.65			0.03		
01-07	Aramatau river downstream	0.04	0	0.425	4.65		0.48	0.03	0.19	
02-01	Sipaliwini river Upstream camp 2	0.125	0.01	0.535	6		1.17	0.05	0.15	
02-02	Creek upstream camp 2	0.085	0.01	1.055	8.5	0.71	1.02	0.03	0.14	0.80
02-03	Sipaliwini river upstream camp 2	0.08	0.01	0.585	6.55					0.54
02-04	Sipaliwini river downstream camp 2a	0.065	0.025	1.15	7.85	0.51	1.24	0.07	0.16	0.76
02-05	Creek downstream camp 2 (a)	0.045	0	0.395	7.6	0.57	0.98	0.06	0.23	
02-06	Creek downstream camp 2 (b)	0.08	0.01	0.375	7.9				0.26	
02-07	Sipaliwini river downstream camp 2	0.11	0.02	0.21	7.8				0.12	
02-08	creek downstream camp 2	0.065	0	0.765	6.55	0.59	0.99	0.03		
03-01	Sipaliwini river upstream camp 3 (a)	0.09	0.01	0.27	8.2			0.07		
03-02	Sipaliwini river-upstream camp 3	0.12	0.015	0.755	9.65			0.07		
03-03	Creek downstream camp 3	0.055	0.01	0.285	7.45	0.90	1.28	0.06	0.27	0.42
03-04	Sipaliwini river downstream camp 3	0.145	0.005	0.705	8.35	0.79	1.29	0.08	0.15	
03-05	Creek Wioemi midstream	0.08	0	0.45	7.6	0.89	1.15	0.03	0.26	
03-06	Creek Wioemi upstream	0.145	0	1.04	7.3	1.02	1.56		0.24	
03-07	Creek Wioemi downstream (a)	0.065	0.025	0.66	8.8	1.12	1.73	0.02	0.22	
03-08	Creek Wioemi downstream (b)	0.065	0.015	0.535	6.95	0.73	1.20	0.00	0.22	