Water Quality Assessment of the Palumeu River

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Source: A Rapid Biological Assessment of the Upper Palumeu River Watershed (Grensgebergte and Kasikasima) of Southeastern Suriname: 52

Published By: Conservation International

URL: https://doi.org/10.1896/054.067.0110

Chapter 2

Water quality assessment of the Palumeu River

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SUMMARY

During this assessment we sampled water quality at 14 sites on the Palumeu River, Tapaje Creek and Makrutu Creek. In general the result show typical water quality conditions for undisturbed aquatic ecosystems in Suriname's interior, except for mercury. Although analysis of rain water samples taken on the Grensgebergte did not have any mercury, levels above international norms were occasionally found in sediment and fish tissue samples. This indicates that there might be an external mercury source. Further monitoring is needed to confirm this. This aspect is very important and needs immediately action because these headwaters provide drinking water and protein source for many local communities downstream.

INTRODUCTION

Although most of Suriname's rivers have their origin in the south of Suriname, little is known about water quality near the headwaters of these south-north meandering rivers. Most of these source rivers drain the extensive mountain range that forms the south border of Suriname. One of these rivers, assessed during this RAP survey, is the Palumeu River, draining the mountainous area in Southeastern Suriname. The main river springs from the Grensgebergte mountains, while big and small tributaries of the Palumeu River drain other parts of the Grensgebergte (for example Tapaje Creek), Toemoek hoemak gebergte (for example Makrutu Creek) and Oranje gebergte (Makrutu creek). Baseline water quality data for this area is very limited. Assessment of water quality in this area is not only important for ecological reasons, but also to identify if the water is safe to be used as drinking water for villagers within and downstream from the area assessed.

Parameters to measure were selected mainly to obtain a general impression of water quality in the area, and to test for the effects of disturbance. Anthropogenic disturbance was not expected, because of the position and remoteness of the assessed area, (Ouboter et al. 2012). Ouboter et al. (2012) predicted that due to the NE trade wind mercury is transported SW inland, causing mercury deposition on the lee side of the mountainous area in mid West Suriname. According to this prediction both the NW and the SE areas would have minimum mercury deposition. Parameters (for example turbidity and metals) were selected to confirm this.

SITES

Sampling was conducted around three major sites on the Palumeu river (in total 14 sites; Figure 2.1): upstream Palumeu river near the Grensgebergte (7 sites), one site on the Grensgebergte, upstream to midstream Palumeu river (4 sites), and midstream Palumeu river (2 sites).

The upstream portion of the Palumeu River is narrow and creek-like, with a maximum width of 20 m, shallow clear water, white sand, strong meandering, overhanging vegetation, swamp vegetation, and seasonally flooded creek forest. Upstream to midstream, the Palumeu River gets wider and less meandering with steep walls and high dry land forest. Tapaje Creek is structurally similar to the midstream portion of the Palumeu River,with steep walls and high dry land forest, while Makrutu Creek has a lot of moko moko swamp forest downstream along the creek. Downstream of the Tapaje and Makrutu Creek the Palumeu River starts to have rapids and rocky forest islands.

METHODS

We measured 11 physico-chemical parameters at each site: pH, dissolved oxygen, conductivity, temperature, alkalinity, total phosphate, nitrate, chloride, tannin & lignin, ammonia and turbidity (Appendix 2.1). At selected sites, water samples were saved for later analysis for mercury, iron, and aluminum at the University of Suriname in Paramaribo. Sediment and fish tissue samples were taken opportunistically for mercury analyses. All stored samples were kept under refrigeration in the field. Titrimetric, spectrofotometric and colorimetric methods were used to assess the parameters.

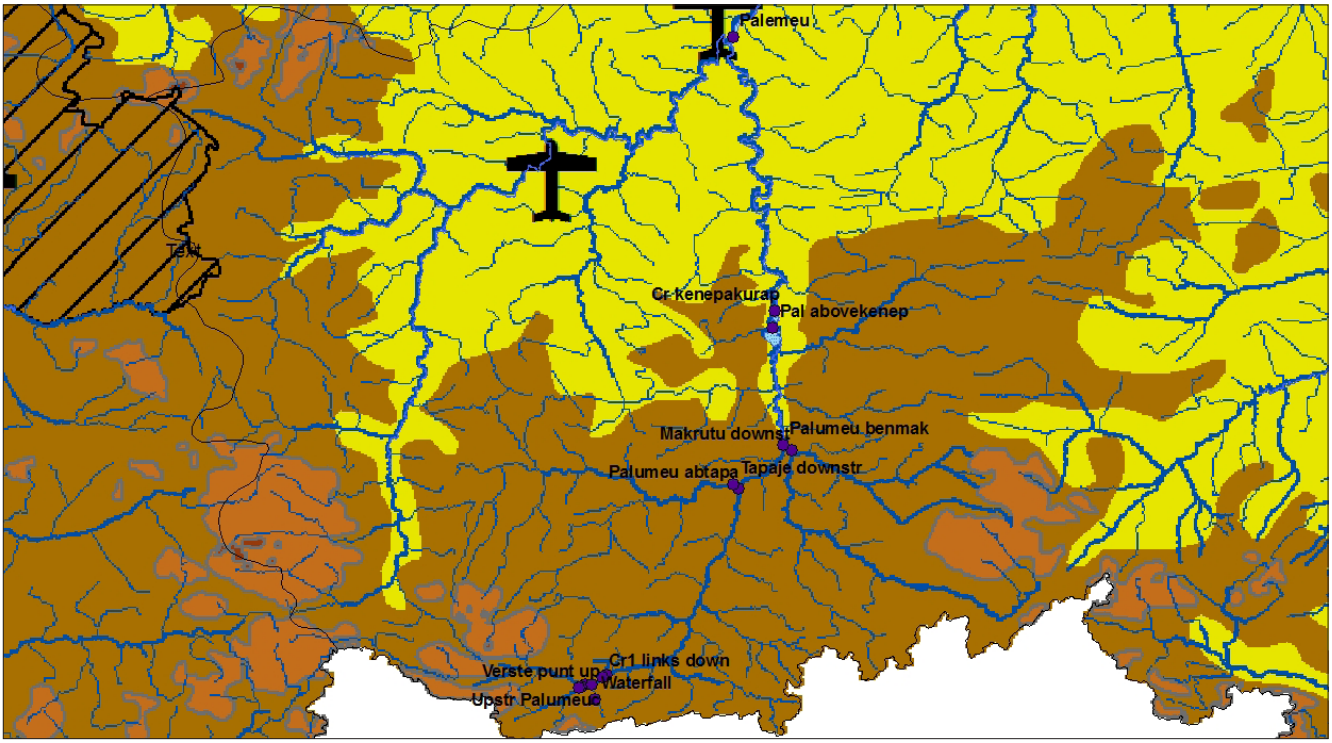

Figure 2.1. Water quality sampling sites during the 2012 RAP survey.

RESULTS

The results of the assessed parameters can be found in Appendix 2.1. In general, the creeks of the Palumeu River show lower oxygen levels (1.72 – 7.93 mg/L) than the main river (5.58 – 7.34 mg/L) mainly due to the lack of rapids in the creeks. Due to organic input from the forest, nutrient concentrations are higher in the creeks (phosphate: max 0.13 mg/L; ammonia: 0.09 mg/L; nitrate: 0.02 mg/L) than in the river (phosphate: max 0.11 mg/L, ammonia: 0.08 mg/L, nitrate: 0.01 mg/L). Both creeks and river have relatively clear water (max turbidity: 11 NTU, which was measured after rain). Concentrations of both aluminum and iron were found in creeks (aluminum: 0.33 mg/L average, iron: 0.80 mg/L average) and rivers (aluminum: 0.36 mg/L, iron: 0.59 mg/L). The results of the analysis of rainwater, gathered on top of the Grensgebergte granite outcropping, showed that there is deposition of aluminum and iron with rain in the area. Mercury concentrations in water were low in both creeks (0.00 – 0.06 µg/L) and river (0.02 – 0.06 µg/L), and there was no mercury found in the Grensgebergte rainwater. Mercury levels in sediment were higher in creeks (0.16 µg/g average) than in the river (0.19 µg/g average). For fish, mercury levels measured in *Hoplias aimara*, (N=4) caught in the Palumeu River (furthest point upstream) were on average 0.59 µg/g and in *Serrasalmus rhombeus* (N=1), caught in the Makrutu Creek, 0.36 µg/g.

DISCUSSION AND CONCLUSIONS

Compared to other sites, the data imply typical water quality conditions for undisturbed aquatic ecosystems in the interior for all creeks and river sites assessed (O'Shea et al. 2011, Alonso and Berrenstein 2006, Ouboter 1993), except in the case of mercury. No mercury was detected in rainwater, at least at the level of precision of hundredths of micrograms per liter, which implies that deposition of mercury with rain in the area is minimal. compared to other pristine sites, for example the Tafelberg in the Central Suriname Nature Reserve, where 0.11 µg/L was found in rainwater (unpublished data). This is in line with the hypothesis proposed by Ouboter et al. (2012) that mercury is being transported inlands by the northeast trade wind and deposited by rain in the mid-West southern mountain ranges.

Consequently, high levels of mercury occur in rivers in southwestern Suriname even in remote, undisturbed areas such as around Kwamalasamutu (Landburg and Hardjoprajitno 2011). Consistent with this hypothesis, we did not expect to find mercury pollution in the current study sites which are located farther to the east, out of the Norteast trade wind direction. Mercury levels around Kwamalasamutu were in some cases more than two times higher than those found here. The watersheds of Southeastern Suriname appear to be sheltered from this phenomenon and may support one of the cleanest freshwater in all of the country. Nonetheless, compared to the global background levels for mercury in sediment of 0.01 – 0.05 µg/g (Anderson

1979), the mercury levels found in the samples are still high. Mercury levels in fish were on average slightly higher than the European Union standard for human consumption of 0.5µg/g (EC 2002) for the Palumeu River but lower for the Makrutu Creek. Although these upper watershed sites are isolated from any potential impacts of mining further downstream, they do appear to be affected by atmospheric mercury deposition; probably from transboundary sources. This area may be out of position to be affected by mercury pollution from downstream sites but is not spared from transboundary mercury pollution.

Protecting the headwaters of Southeastern Suriname and minimizing mercury pollution from neighboring countries will be important for safeguarding this source of clean freshwater for especially the traditional communities more downstream who are using this water as drinking water and protein source.

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Appendix 2.1. Water quality of the Palumeu River.

Location #	Location name	Coordinates		Location description	Date	Time	Weather condition	pH	Conductivity (µS/cm)	Temperature (°C)	Dissolved oxygen (mg/L)	Dissolved oxygen (%)	Alkalinity (mg/L CaCO3)	Tanin Lignin (mg/L)	Phosphate (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)	Turbidity (NTU)	Chloride (mg/L)	Aluminium (mg/L)	Iron(mg/L)	Mercury water (mg/L)	Mercury sediment (µg/g)	Mercury fish average (µg/g)	Remarks
1	Palumeu river, upstream Palumeu Camp	21 N 652292	273868	River, 15–20 m width, trunks in the river, vegetation over the water	10/3	17:00	cloudy	5.5	20	23.9			5.2	5.1	0.05	0.01	0	7	5.7	0.32	0.82	0.03	0.16		rain during the day
2	Waterfall creek across Palumeu camp	21 N 652731	271528	Creek, ± 60–70 m high; clear water, rocks; sandy substrate in creek	11/3	11:00	sunny	5.9	20	23.5			4.75	2.6	0.03	0.01	0	5	3.2	0.28	0.33	0.03			
3	Creek 1 downstream	21 N 653902	274917	Creek, clear water, sandy substrate, slow current, trunks in the creek, vegetation over the creek	12/3	10:59	cloudy, sunny	5.6	15	22.9	1.72	20	3.5	0.9	0	0.01	0.04	4	3.6	0.27	0.52	0.03	0.15		
4	Creek 1 upstream	21 N 651429	273890	Creek, ± 25 m width, vegetation over the creek, steep walls, trunks in the water, fast current	13/3	11:30	sunny	5.7	14.1	22.6	7.22	83.4	5.3	5	0.07	0.02	0.07	11	5.5	0.38	1.1	0	0.17		
5	Creek 2 upstream camp	21 N 650745	273444	Creek, vegetation over the creek, clear water, slow current, trunks in the water, steep walls	14/3	12:30	cloudy, sunny	5.6	17.2	22.7	7.42	86	5.5	3.6	0.13	0.02	0.07	7	3.5	0.33	0.79	0	0.16		
6	Furthest point upstream Palumeu river	21 N 650466	273281	River gets the character of a creek, 5-10m width, sandy bottom, clear water, fast running, shallow, vegetation over the creek	14/3	14:45	cloudy sunny	6.0	18.2	22.9	7.34	85.2	6.65	3.325	0.11	0	0.08	9	3.4	0.31	0.83	0.02	0.16	0.59	

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Appendix 2.1. *continued from previous page*

Location #	Location name	Coordinates		Location description	Date	Time	Weather condition	pH	Conductivity (µS/cm)	Temperature (°C)	Dissolved oxygen (mg/L)	Dissolved oxygen (%)	Alkalinity (mg/L CaCO3)	Tanin Lignin (mg/L)	Phosphate (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)	Turbidity (NTU)	Chloride (mg/L)	Aluminium (mg/L)	Iron(mg/L)	Mercury water (mg/L)	Mercury sediment (µg/g)	Mercury fish average (µg/g)	Remarks
7	Creek 2 downstream camp	21 N 654466	275245	Creek, 10–20 m width, very slow current, abundant vegetation in and over the creek, deep; clear water	15/3	10:30	very cloudy	5.6	19.3	23.1	4.58		6.5	0.2	0.04	0	0.09	9	4.5	0.32	2.31	0.06	0.17		rain in the night
8	Tapaje creek downstream	21 N 673367	303638	Creek, ± 100 m width; clear water, fast current; terra firme forest	19/3	10:45	cloudy sunny	5.3	11.7	23.6	6.40		1.9	6.7	0	0.02	<0.008	6	3	0.38	0.39	0.06	0.27		
9	Downstream Palumeu above Tapaje	21 N 674285	302969	River, fast current, above rapids, clear water	19/3	12.01	cloudy sunny	5.6	13.7	23.7	5.58	66	2.2	2.5	0.07	0.01	<0.008	11	3.6	0.35	0.41	0.06	0.15		
10	Makrutu creek downstream	21 N 682107	308705	Creek, 60–100 m width, floodplains, moko moko vegetation, clear water, fast current	20/3	10:45	cloudy	5.6	15.3	23.8	5.31	63	2.8	4.3	0.03	0	0.07	8	4	0.29	0.54	0.06		0.36	
11	Palumueu river downstream Makrutu creek	21 N 680949	309517	River, above rapids, fast current, rocks in the water	20/3	10:57	cloudy	5.5	13.1	23.7	5.64	67	2.2	2.4	0.09	0	0.03	9	3.5	0.45	0.43	0.02			rain in the night
12	Creek Kenepaku rapid, downstream camp	21 N 679570	329530	Creek, 5-10 m, rocky substrate, vegetation in and over the water, very slow current	22/3	9.05	cloudy sunny	5.9	15.7	23.2	6.59		3.95	0.9	0.06	0	0.01	2	1	0.35	0.37	0.02			
13	Palumeu river upstream of Kenepaku camp	21 N 679320	326922	River, fast current, clear water	23/3	9:30	cloudy sunny	5.5		23.9	7.93	94	2.05	2.2	0.06	0	0.03	6	3	0.37	0.45	0.03			
14	Rainwater Grensgebergte rock			Granite outcropping	14/3	9:00	cloudy, rain													0.31	0.05	0			