Shimanto River Environmental Survey

Shimanto River and Kubokawa Area

3 July 2022

1. Outline of Situation

We arrived at Kochi Airport on Sunday, July 3. Typhoon No. 4 (985 hectopascals at 15:00 on July 3, west of Okinawa), which originated in the southwest Japan on July 1, moved northeast at 30 km/h, made landfall near Nagasaki City at 8:00 on July 4, and hit near Uwajima City in Ehime Prefecture after midnight on July 4, so Shimanto City was directly affected by this typhoon.

By the time we arrived at the Kubokawa area, the rain had temporarily stopped. After lunch, we started our survey at the Niida Bridge on the Niida River, the Yoshimi Bridge and Shinkai Bridge on the Yoshimi River, and the Taiino Bridge on the Shimanto River. We then proceeded to the Saga Weir (Iechi River Dam), where we conducted scientific measurements at the same points as the survey conducted in March 2022. During this period, we were affected by the typhoon, but fortunately it did not rain, so we did not interrupt our survey activities. After the survey at the Saga Weir was completed, based on our previous study, we selected the Mukouhirose Chinka Bridge downstream as a location where the influence of the Saga Weir was lessened and a comparison with the weir was possible, and conducted measurements there.

Photograph 1: Near roadside station by the Niida River, 3 July 2022
Turbid water volume increased due to Typhoon No. 4 and overflowed from the weir.

2. Results of Survey

Key findings

(1) It is necessary to search for the source of muddy water runoff and consider measures to prevent soil runoff, which causes the muddy water. The survey was conducted during abnormal weather conditions caused by an approaching typhoon, which resulted in an extreme increase in water volume, and this definitely affected the water quality, volume, and velocity of the river. The most affected measurement was turbidity (FTU).

(2) It was suggested that the high turbidity (FTU) values in the Iechi River may also be caused by agricultural activities such as ginger farming. A survey of agriculture in the upper reaches of the Iechi River will be necessary in the next and subsequent surveys.

(3) Near the Niida River Bridge:

The weir below the Nieda River bridge was in a state of drought at the time of the March 14, 2022 survey, and no water flowed over the weir at all. However, on July 3, rainfall increased due to Typhoon No. 4, and the water turbidity increased, resulting in a large flow of dark brown-colored water. The flow speed was remarkably fast, ranging from 176 to 318 centimeters per second. At the time of the previous survey, the water was almost stationary. These streams were flowing out over the weir. Naturally, the river looks completely different at different times and in different weather conditions. The turbidity of the river water is dark brown, and although a large amount of sediment is dissolved into its volume, this eventually settles out and clogs the habitat of microscopic organisms by getting in between the pebbles and gravel.

The turbidity (FTU) was extremely high at 89.9 FTU. This is thought to be due to mud flowing into the river water, which caused the high turbidity (FTU). There was no chlorophyll content at all (zero μg /ℓ). It is assumed that the flow was too fast to produce chlorophyll content and that there was no stagnant space. The oxygen content was 98.7%, indicating that there was sufficient oxygen dissolved in the water.

It is estimated that the typhoon has increased the volume of water, and that the water has washed away mud from the sides of the river, mountainsides, farmlands, flatlands, and construction sites, increasing the turbidity (FTU) of the Shimanto River.

1) Difference in Water Temperature between Main Stream and Tributaries

Regarding water temperature, a large difference in water temperature was observed between the main stream and tributaries of the Shimanto River at the time of the March 2022 survey, and the difference was observed again this time. However, unlike the previous survey, the water temperature was 22.9°C in the tributary Nieda River and 24.8°C in the main stream of the Shimanto River, indicating a higher water temperature in the main stream. This is exactly the opposite phenomenon from the previous survey in March. Last time, the temperature was 18.25°C at the Niida River Bridge and 17.7°C at the Taiinogawa Bridge on the main stream of the Shimanto River, with the main stream being lower than the tributaries. Even at the Mukouhirose Chinka Bridge, the water temperature in the main stream was even higher at 26.4°C. In the Niida River, the temperature rose by 4.75°C from March to July during this period, but in the main stream of the Shimanto River at the Ooino Bridge, the temperature rose by 7.1°C.

The reason why these phenomena of significantly higher water temperatures in the mainstem than in the tributaries are occurring is a subject for future study. In any case, it was found that the temperature difference between the tributaries and the main stream was greater in summer.

Chart 1: Chlorophyll content, turbidity, dissolved oxygen and current direction and velocity at the Niida River Bridge

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mainstream than in the tributaries are occurring is a subject for future study. In any case, it was found that the temperature difference between the tributaries and the main stream was greater in summer.

Chart 2：Rhlorophyll content, turbidity, dissolved oxygen and current direction and velocity at the Yoshimi River, Shinkai Bridge and Ooino Bridge on 3 July 2022

2) In the former Kubokawa Town: Yoshimi River Bridge and Shinkai Bridge and Ooino Bridge on the main stream of Shimanto River

Chlorophyll levels were completely absent in the vicinity of the Yoshimi Bridge, as was the case at the Niida Bridge.

However, the Shinkai and Taiino Bridges showed higher values of 3.3 μg /ℓ and 4.1 μg /ℓ, respectively.

Turbidity (FTU) was also remarkably high near Shinkai Bridge at 78.7 FTU. The dark brown water color is mostly due to mud. It is also important to determine the source of these muddy waters. Mud has no positive effect on organisms. The turbidity (FTU) is characterized by abnormally high levels at all sites. It is thought that the typhoon caused an increase in water volume, and water-laden sediments were washed into the river. It is

necessary to determine whether this is from river construction sites, farmlands, and roads, and where are the high and low points where soil runoff occurs. Excessively high turbidity (FTU) may be evidence that sediment is being wasted into the river and ocean. This can lead to disturbance and degradation of terrestrial, riverbank, and coastal ecosystems.

Photograph 2: View from the Yoshimi River Bridge to the upper stream on 3 July 2022

Photograph 3: View from the Shinkai Bridge to the down stream on 3 July 2022

3) Saga Weir and Mukouhirose Chinka Bridge

Water flow within the Saga Weir was stagnant and had almost no velocity (see Figure 3). However, the chlorophyll content was also high, but the chlorophyll content at the point where the Iechi River flows into the Saga Weir Lake was the highest at 23.1 μg/ℓ, and the turbidity (FTU) was even higher than in the weir at 10.3 FTU. The water quality of the Iechi River, which flows into the Saga Weir, was even dirtier with visible turbidity in comparison (See Photo 6).

Turbidity within the weir ranged from 1.4 to 2.2 FTU. Turbidity (FTU) at the Chinka Bridge of Mukouhirose was 5.0 FTU, which was also higher than the water quality within the Saga Weir. It was lower than the turbidity (10.3 FTU) in the Iechi River. However, the prediction that turbidity would be lower because it was downstream of the weir did not hold true.

The turbidity (FTU) was so high near the mouth of the Iechi River. An elderly woman (in her 80s) in the neighborhood told us that there were three ginger farms and several rice farms upstream, and that pesticide and fertilizer runoff from these farms may have caused the turbidity (FTU).

4) Direction and velocity of flow at all locations

Heavy rainfall due to the typhoon is thought to have resulted in a large amount of rainwater flowing into the river and increasing the flow velocity. Thus, the flow velocities were 67 to 86 cm/sec at the Niida River, 176 to 318 cm/sec at the Yoshimi Bridge, 86 to 94 cm/sec at the Shinkai Bridge, 120 to 182 cm/sec at the Ooino Bridge, and 63 to 99 cm/sec near the Chinka Bridge in Mukouhirose. These readings taken in March 2022 were completely different when the Niida River was almost motionless. Since the other measurement points also ranged from 1 cm to 10.7 cm/second, it is clear from this that the river shows a completely different aspect depending on weather conditions.

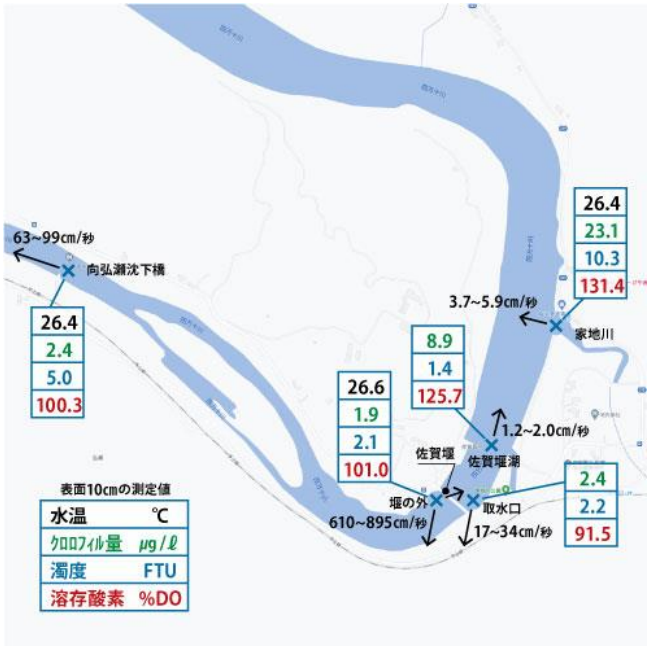

Chart 3: Chlorophyll content and flow direction and velocity at Saga Weir and the Chinka Bridge in Mukouhirose

3. Evaluation of survey results

(1) It is necessary to investigate the source of the muddy water and to consider measures to prevent the soil that causes the muddy water from flowing out. The survey was conducted during a typhoon, which caused an extreme increase in water volume, and this definitely affected the water quality, volume, and velocity of the river. The most affected measurement was turbidity (FTU). The extreme increase in turbidity (FTU) may be due to sediment discharge from the typhoon.

(2) The high turbidity (FTU) of the Iechi River may also be caused by agricultural activities such as ginger farming. The results of the previous surveys also indirectly confirmed the assumption that agriculture is one of the four sources of pollution.

(3) At the time of the March 2022 survey, the river was in a state of drought and the results were completely opposite to the July survey results. Scientific surveys need to be conducted throughout the year in order to understand the characteristics and current status of rivers, and more useful data can be accumulated if these surveys are continued on a yearly basis. Comparison and examination of the data across the years will be possible, and the situation of each area of the Shimanto River will be more deeply

understood.

Photograph 4: View from the Ooino Bridge (Kubokawa Bridge) to the Shimanto River downstream on 3 July 2022

Photograph 5: Aggravated water quality near the mouth of the Iechi River. The water color is brown compared to that of the Saga Wier lake (blue color). Some floating trashes are observed. 3 July 2022

Photograph 6: Saga Wier Lake on 3 July 2022

Although extremely turbid and muddy water was flowing in from the Kubokawa area and Iechi River upstream, at this point (around 1:30 p.m. on July 3), there was still no inflow of turbid water caused by the typhoon.

Photograph 7: View from the Chinka Bridge in Mukouhirose toward the downstream

At first glance, it appears to be a typical clear stream of the Shimanto River, but the turbidity (FTU) is very high at 5.0 FTU and it is polluted.