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The impact of Shimen Reservoir's increased the ability of sediment flushing to Common Teal habitat suitability on downstream wetland

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Abstract

The Shimen Reservoir is one of the important reservoirs in northern Taiwan and provides water for millions of people. In order to extend its service life, it is necessary to reduce siltation during typhoons, which may impact the downstream river ecosystems. In this study, the Total-station with the Non-target measurement method, measure the elevation of the position on the beach, and further compare the results of the previous measurements to understand the terrain variety. According to the results of the investigation before and after the Typhoon Soudelor in 2015, the average elevation of the Huajiang wetland was from EL. -0.32m to -0.30m, and the sediment accumulation height was 0.02m. The habitat suitability index of the Common Teal was still Good level. However, if the wetland deposition trend continues, it may cause habitat degradation. Therefore, it is recommended to monitor the downstream wetland elevation for a long time, to evaluate the long-term impact of Shimen Reservoir's increased the ability of sediment flushing.

Keywords: Reservoir, the ability of sediment flushing, Common Teal, Habitat Suitability, Wetland

1 Introduction

Danshuei River administered by the Central Government is located in north Taiwan and is 158.70 km in mainstream length and 2,726 km^2 in the drainage area. There are three major tributaries of Dahan Stream, Keelung River and Xindian Stream in the Danshuei River Basin. The upper reaches of Dahan Stream are the catchment area of Shimen Reservoir, which directly affects the river section when the flood discharge and siltation operation of Shimen Reservoir is carried out. Shihmen Reservoir was inaugurated in 1963. Landslides in Shihmen Reservoir Watershed were often eroded and collapsed during typhoons and rainstorms. The sediment surged into the river and finally to the reservoir through the flood water. This would induce adverse impacts, such as decreased reservoir storage and increased turbidity. Therefore, how to lead the turbid water to the channel of downstream effectively and reduce the time of turbid water staying would be the most important issue of sustainable reservoir operation.

Shihmen Reservoir did not construct sediment flushing facilities when the reservoir was commissioned. After the improvement of existing facilities and the construction of desilting tunnel, the ability of sediment flushing of the reservoir would be stronger and the reservoir's service life would be extended.The desilting tunnel was opened first time by the Northern Region Water Resource Office Water Resource Agency Ministry of Economic Affairs in 2013. The desilting tunnel attained the result of preventing sediment; the turbidity induced by Typhoon Soulik and Mild Typhoon Trami. To be more specific, the opening of the desilting tunnel in 2013 was contributed to the function of the flood flushing and sediment disposal. In this study, we used the measurement technology with Non-target to observe the topographic changes of the Huajiang Wetland of the Danshuei River before and after the typhoon during the typhoon operation in Shimen Reservoir, and used the Habitat Suitability Index Model (HSI) to assess the trend of habitat quality changes, with reference to the reservoir authority.

2 Materials and methods

The study area is Huajiang Wetland which is at the intersection of Xidian Stream and Dahan Stream (fig. 1). The river width from the intersection to downstream Taipei Bridge located is narrow down to one third (1,200m narrowed to 400m). This condition leads the control section formed during floods. The sediment deposit at the upstream of Taipei Bridge because of rising water level and reducing water velocity and build the Huajiang Wetland. Huajiang Wetland located at the estuary of Danshuei River where the average high tidal level is 1.40m, the average low tidal level is -0.85m and the mean range of tide is 2.25m. The Huajiang Wetland includes sandbars, waters and low mudflats on both banks. The elevation of the mudflat is about -0.5m to 1.5m. There are several small tidal creeks in the Huajiang Wetland, which form a diverse habitat environment of vegetation, bare mudflat and tidal creek. (Cheng et al,2011 ； Lin et al, 2016)

This study expects to comprehend the variety before and after the operation of flood control in the reservoir. Fixed piles that would not be affected by floods and the non-targets measurement method of the TOPCON Total Station (GTS226) were used. First, the Total Station was erected on the levee and the horizontal angle on back sight return to zero. Then, the elevation of the samples on the mudflats and the elevation of the top and the bottom of the fixed piles would be measured. Finally, the difference of elevation before and after the operation of flood control in the reservoir could be understood.

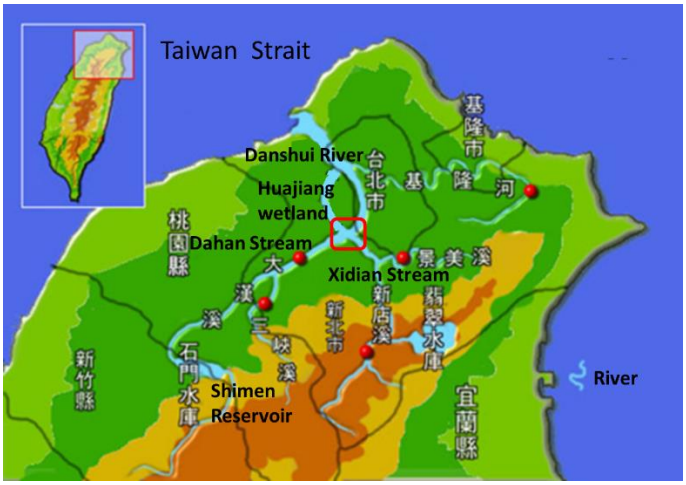

Figure 1: The map of this study area

3 Results and Discussion

The Total Station from Japan TOPCON Company was used to measure mudflats elevation at Huajiang Wetland using the non-target method. In addition, the difference of elevation before and after the operation of flood control during Typhoon Soudelor in 2015 would be analyzed. The result shows the elevation of the mudflats before and after the typhoon (Table 1). The former is about -0.24m to -0.20m and the average is -0.17m. The latter is about -0.40m to -0.17m and the average is -0.15m. Compare with before the typhoon, the average mudflats elevation rise 0.02m. Although the range of error of the instrument (0.020m ~ 0.022m) is close to the variety of mudflats elevation, all the results of samples demonstrated that the sediment deposited in the mudflats. In conclusion, the results still worth to be a guide.

Hsu et al. (2014) examined the Habitat Suitability Index Model (HSI) of wintering Green-winged Teal. The study indicates the optimal elevation of wintering Green-winged Teal is between 0.3m to 0.7m. The secondary is between -1.0m to 0.3m and 0.47m to 2.6m. Also, according to the habitat status classified into four categories based on the HSI values: poor (HSI=0−0.25), fair (HSI=0.26−0.5), good (HSI=0.51−0.75) and excellent (HSI=0.76−1), the elevation of "good" habitat of wintering Green-winged Teal is between -0.3m to 1.7m. Compare to the results of the measurement (Table 1), mudflats elevation are both in the level of "good" habitat (HSI=0.51−0.75) of wintering Green-winged Teal before or after the typhoon.

Tab. 1: The results of the measurement of elevation in Huajiang Wetland before and after Typhoon Soudelor

X	Y	Typhoon Soudelor in 2015	
		before	after
		Z	Z
299332.54	2770944.07	-0.42	-0.40

299319.29	2770945.55	-0.39	-0.37
299318.02	2770945.37	-0.31	-0.31
299320.71	2770912.13	-0.20	-0.17
299311.46	2770938.41	-0.30	-0.26
Avarage		-0.17	-0.15

4 Conclusions

Fixed sample elevation measurement of Huajiang Wetland was carried out by measuring instrument. The results show the average elevation of mudflats before and after Typhoon Soudelor is from -0.32m to -0.3m; the sediment deposited 0.02m. The HSI values of wintering Green-winged Teal is "good" (HSI=0.51−0.75) which means the Huajiang Wetland is fit to wintering Green-winged Teal to live. However, sustained deposal sediment may cause to habitat degradation. Hence, long-term measurement of wetland elevation is necessary.

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