
Balsas river,
Guerrero México.

Dynamics of riparian vegetation as impacted by sedimentation in reservoirs

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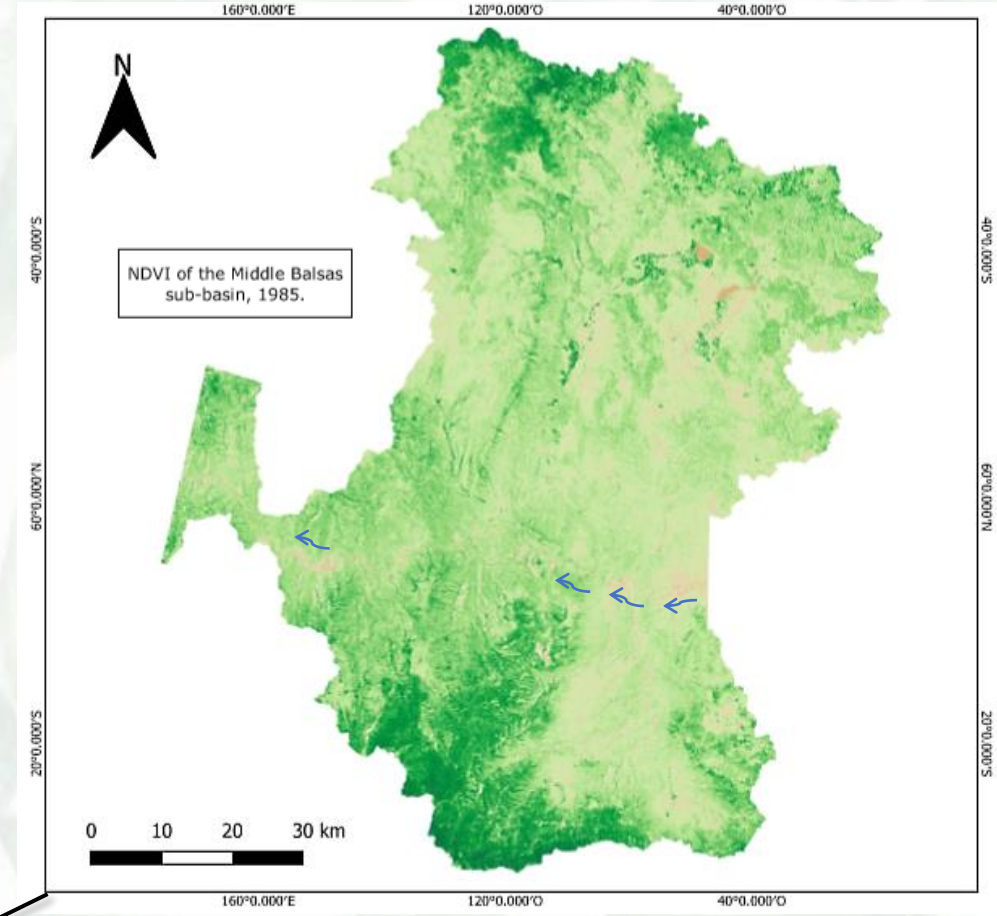
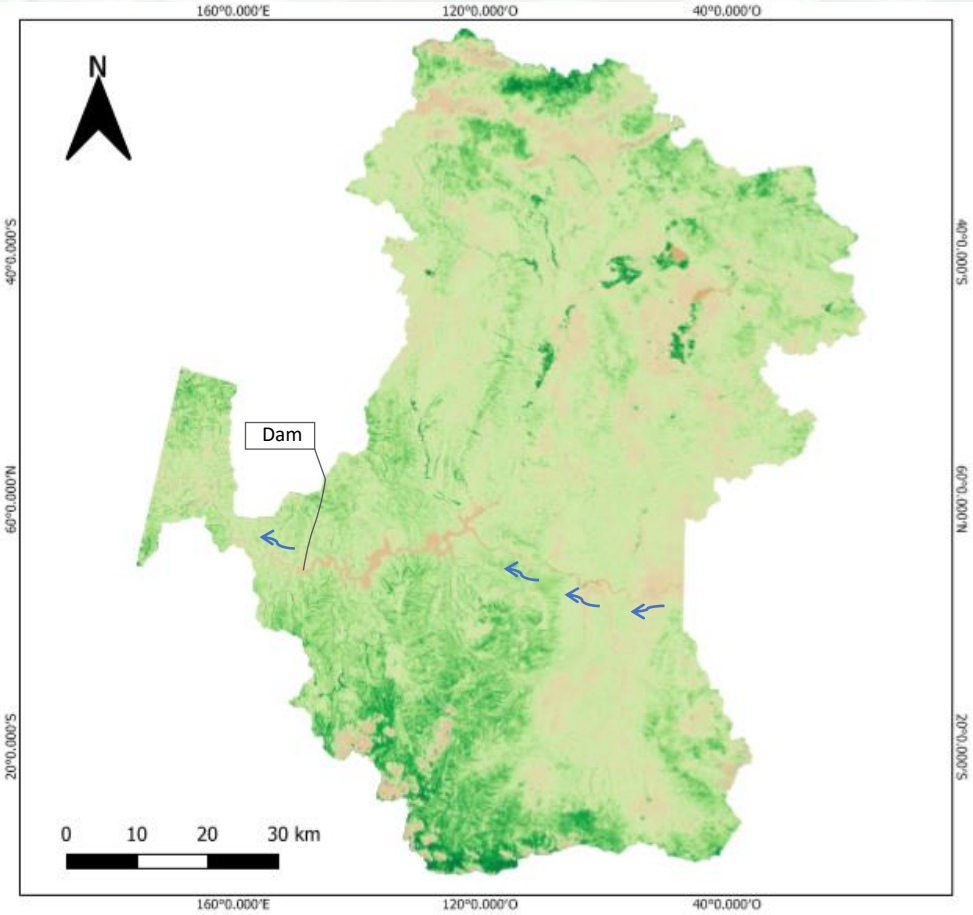
Figure 1. Hydroelectric Dam "El Caracol". Extracted from Google Earth 2019

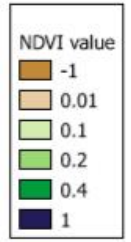
Why dams impact on the dynamics of riparian vegetation in the Middle Balsas is important to study?

- The set of dams for the generation of electrical energy built on the Balsas River represents the second largest hydroelectric system in Mexico.
- The fragmentation of the river system by hydroelectric works causes imbalances in ecological functions. The modification of these ecosystems affects sediment transport and deposition in rivers.
- Sediments retained in a reservoir suggest an impact on the dynamics of the erosion processes and on the equilibrium of riparian ecosystems. Sediments play an important role in the aquatic environment cycle because are responsible for transporting a significant proportion of nutrients and pollutants.
- This work analyzes the **dynamics of the riparian ecosystems**, upstream and downstream of “El Caracol”, a hydroelectric dam located in **Guerrero, Mexico**, based on Landsat TM and ETM + images corresponding to early spring (March-April) for the period of 1985-2010. The analysis was established by **mapping the dynamics of the NDVI** as an indicator of the areas affected by the migration of the vegetation and the erosion of the margins.



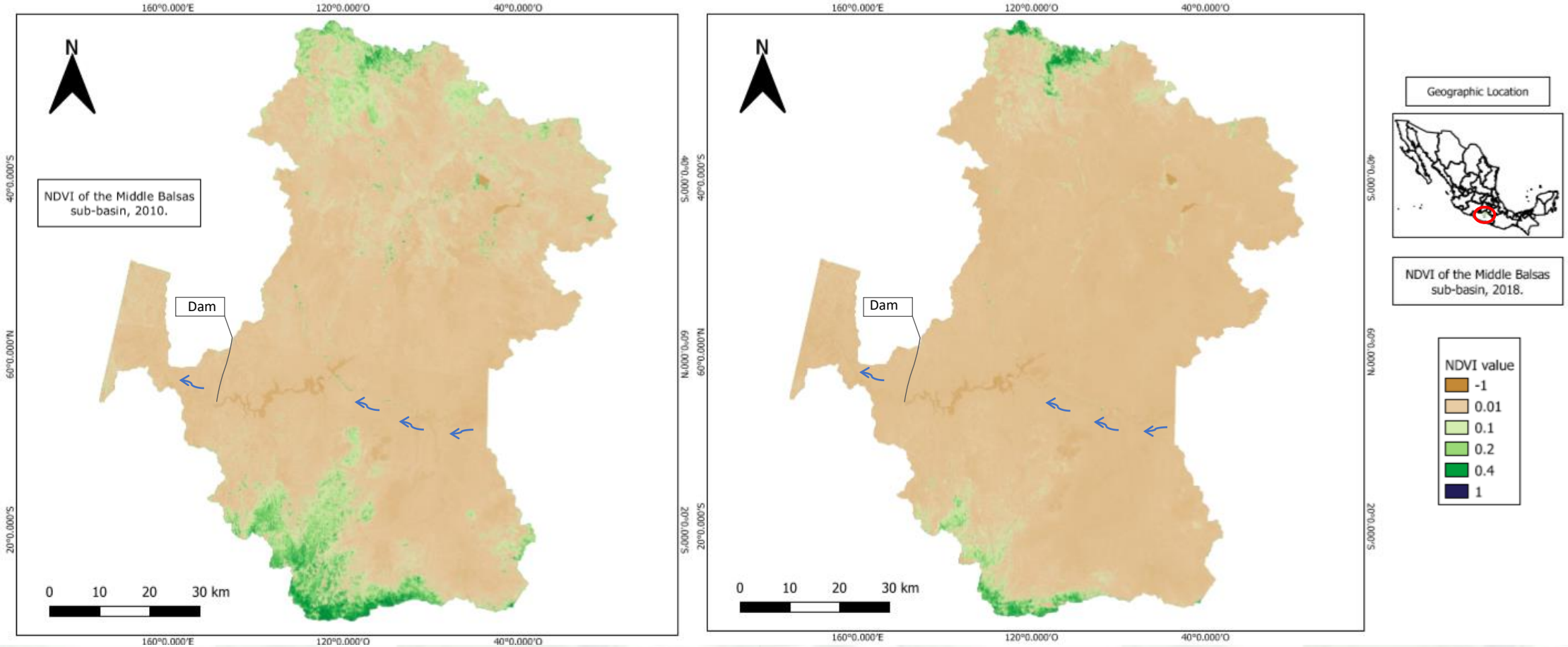


NDVI of the Middle Balsas sub-basin, 1990.

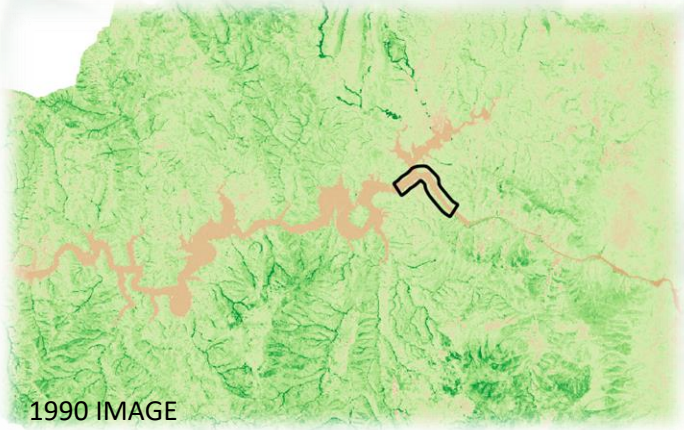


This image corresponds to the before reservoir construction. The "El Caracol" hydroelectric dam began work in 1986.

	SUB-BASIN AREA PERCENTAGE		
	NDVI	**1985**	**1990**
Water body/ Soil without vegetation	**< 0.01**	8.14%	2.67%
Very low vegetation	**0-01 - 0.1**	12.39%	33.46%
Light vegetation	**0.1 - 0.2**	46.66%	47.90%
Medium vegetation	**0.2 – 0.4**	27.65%	14.49%
High vegetation	**> 0.4**	5.17%	1.47%
	TOTAL	100.00%	100.00%

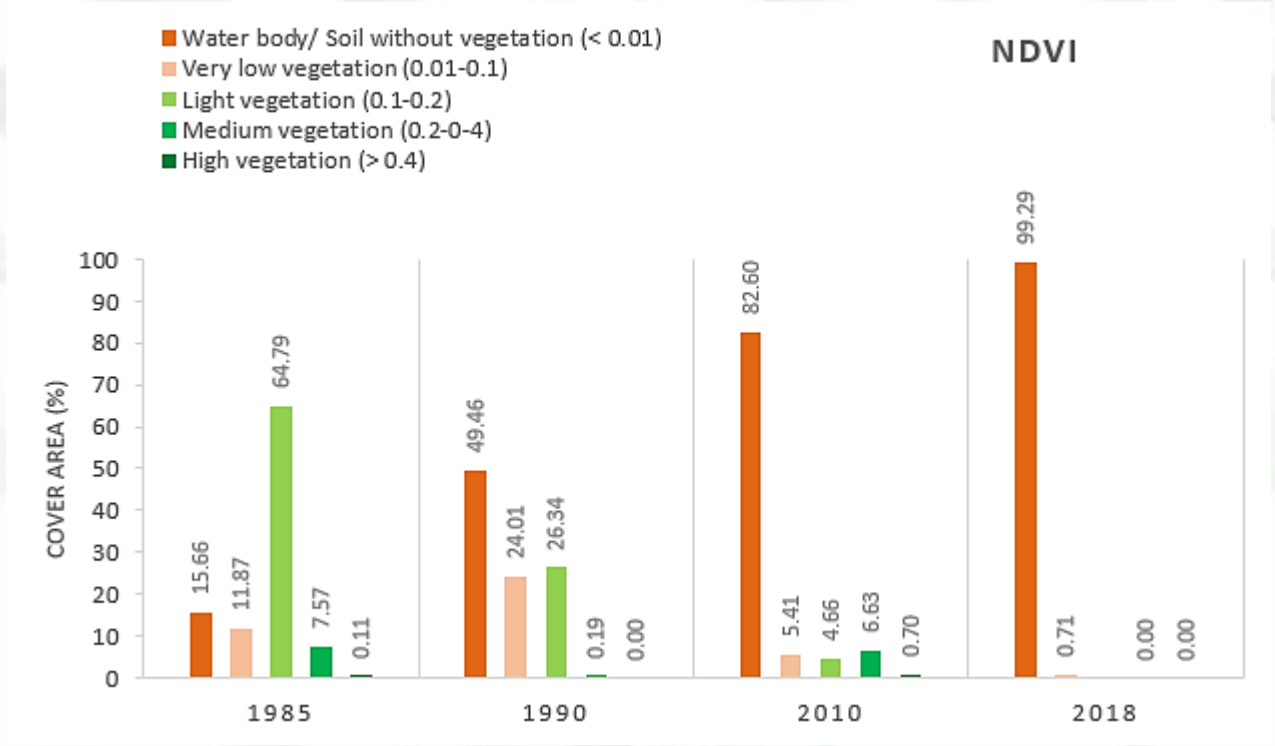


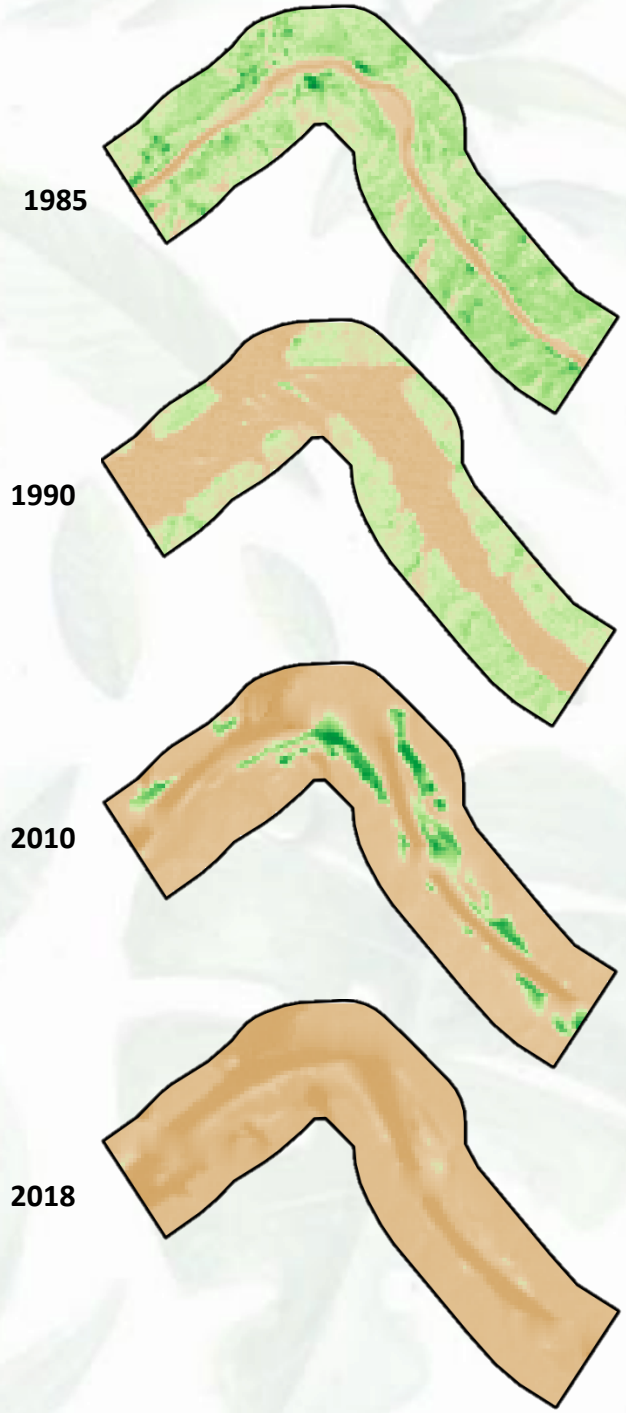
	SUB-BASIN AREA PERCENTAGE		
	NDVI	**2010**	**2018**
Water body/ Soil without vegetation	**< 0.01**	81.09%	93.55%
Very low vegetation	**0.01 - 0.1**	8.93%	3.23%
Light vegetation	**0.1 - 0.2**	5.42%	1.65%
Medium vegetation	**0.2 – 0.4**	4.12%	1.38%
High vegetation	**> 0.4**	0.45%	0.19%
	TOTAL	100.00%	100.00%

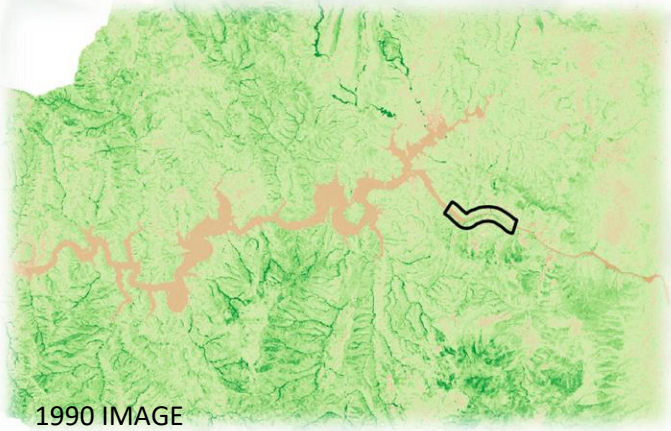


Section #1 upstream of the reservoir

Note: Changes in the vegetation of sections upstream and downstream of the reservoir were analyzed. The sections are 5 km long and 0.4 km wide to study the riparian zone only.

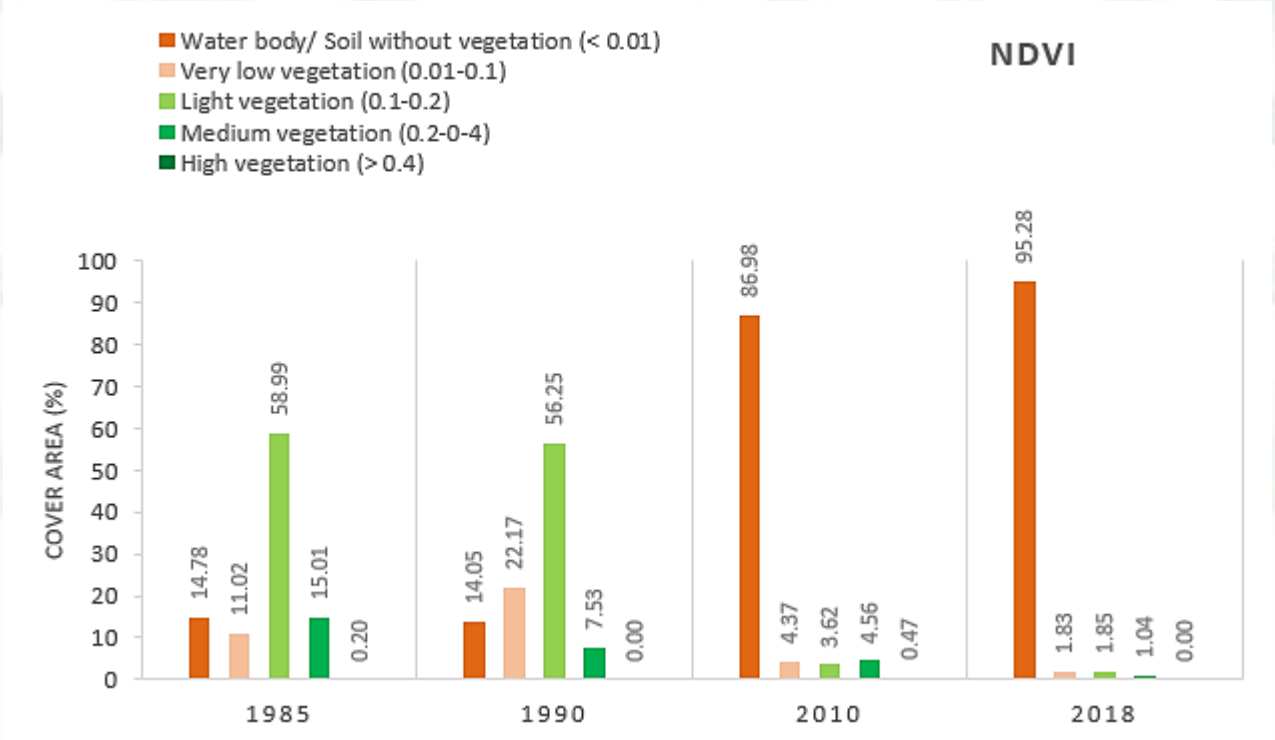






1990 IMAGE

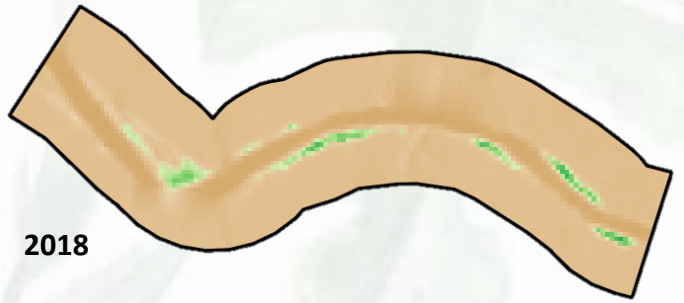
Section #2 upstream of the reservoir



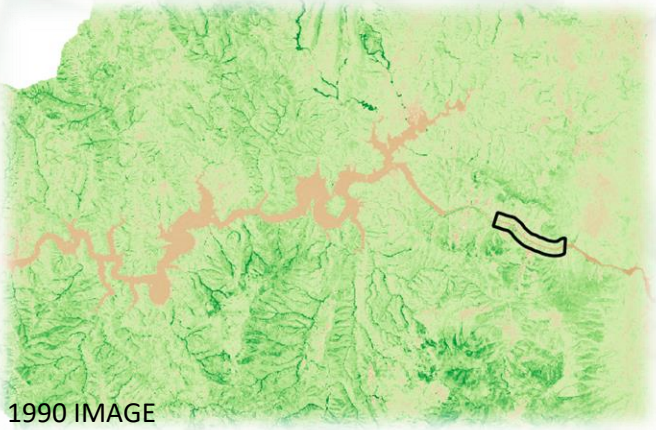
1985

1990

2010

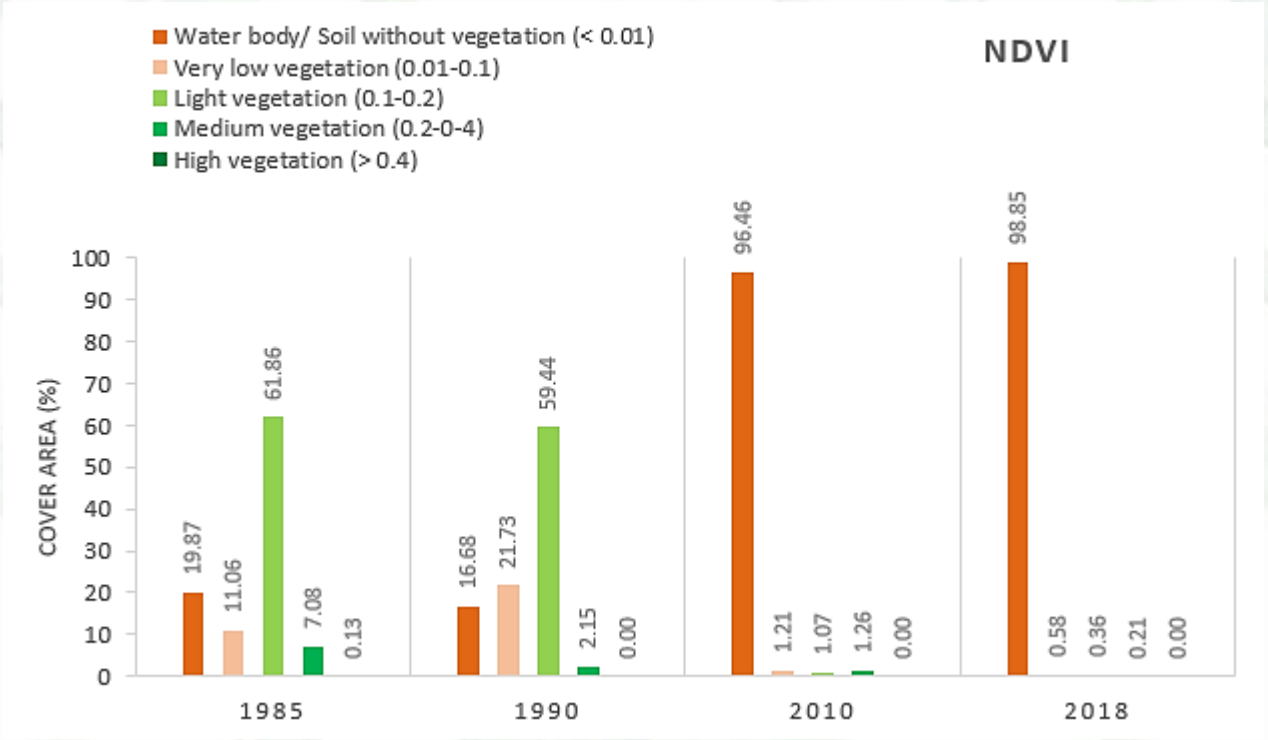


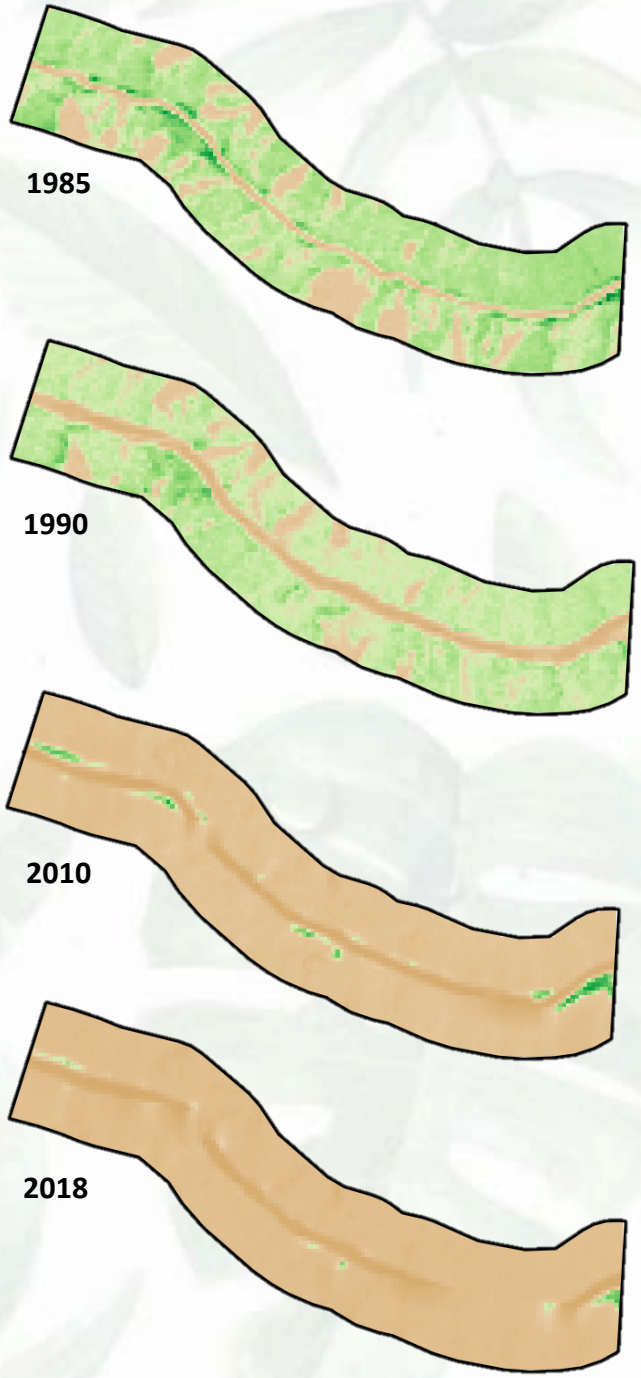
2018

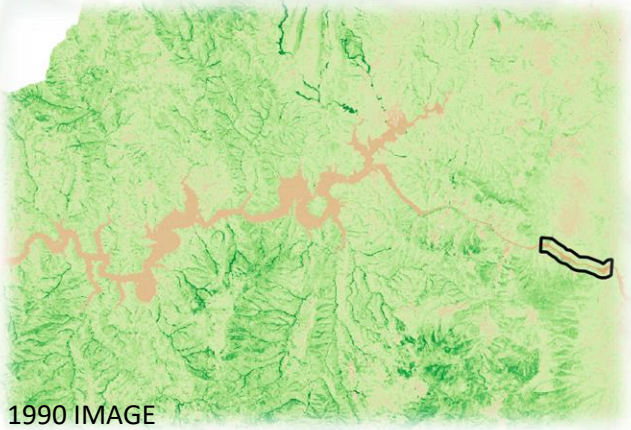


1990 IMAGE

Section #3 upstream of the reservoir

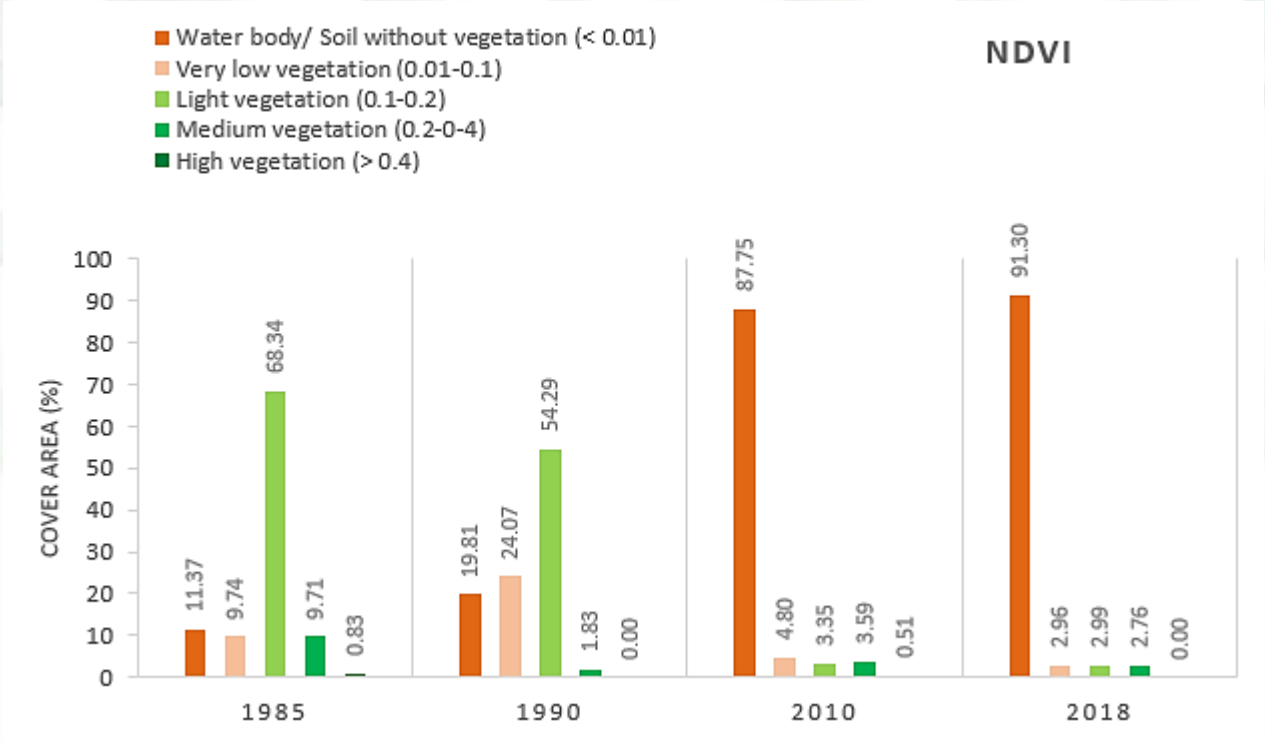


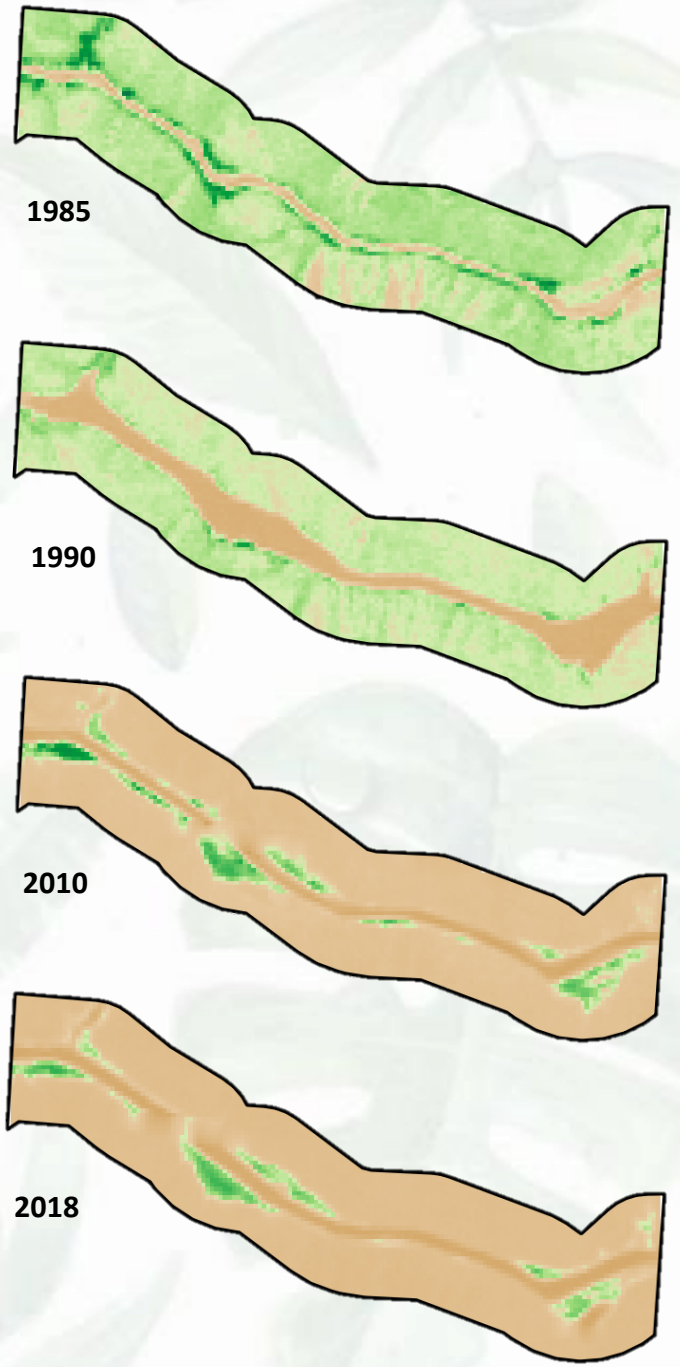


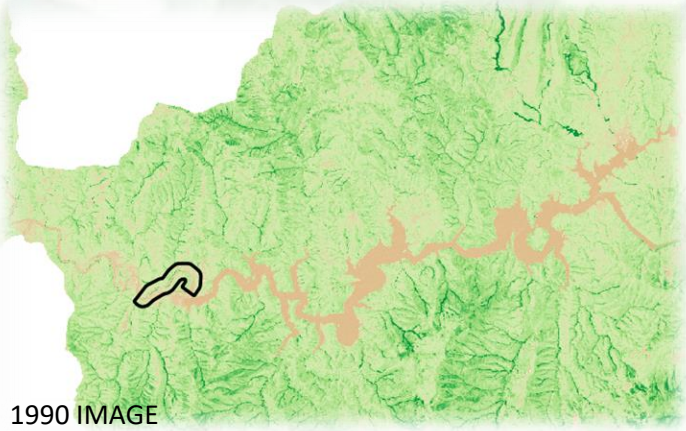


1990 IMAGE

Section #4 upstream of the reservoir

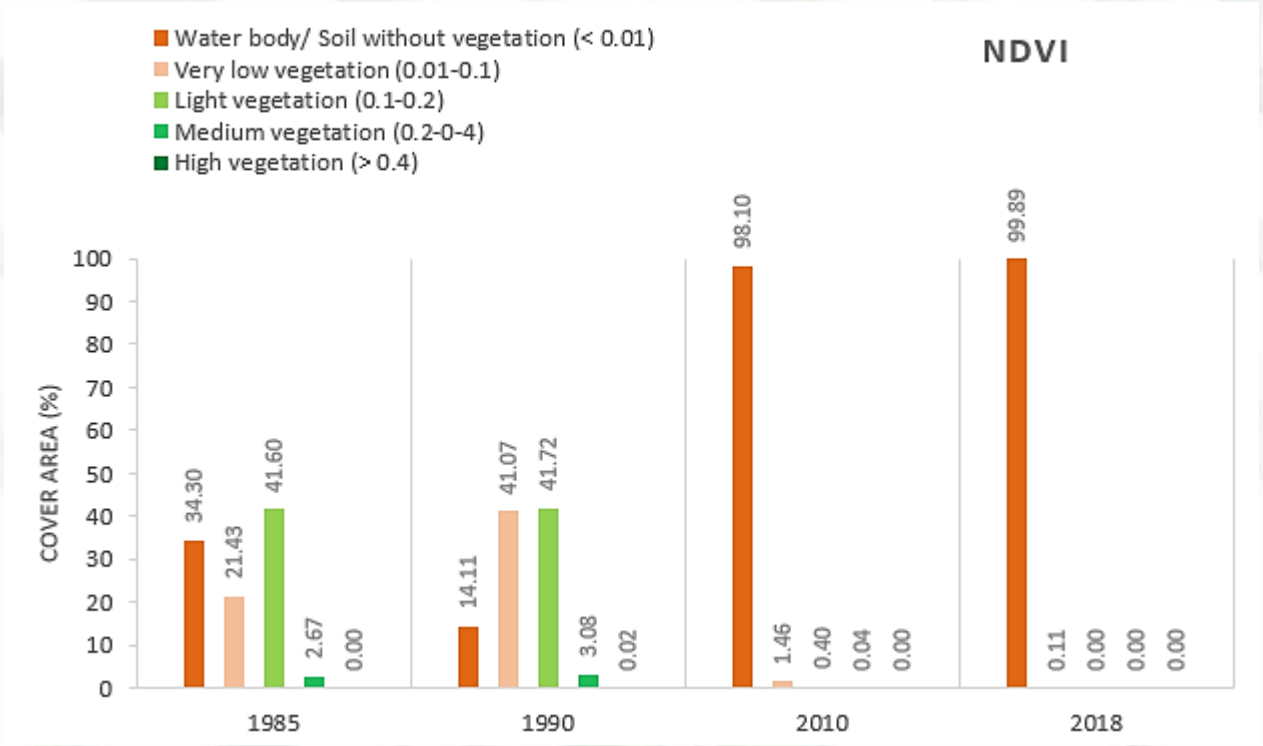


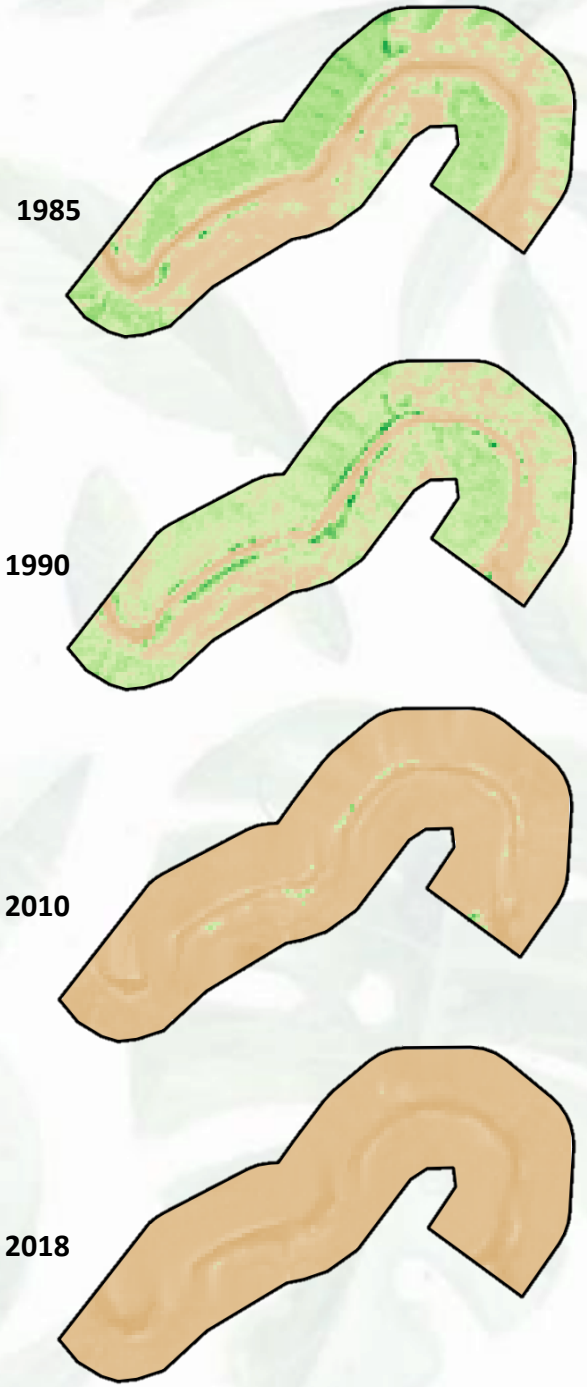


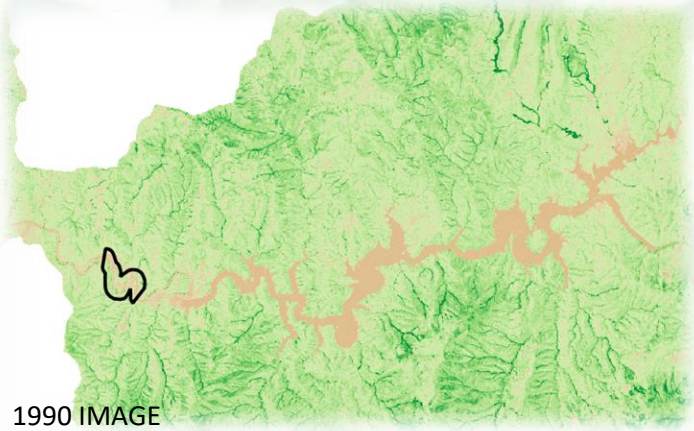


1990 IMAGE

Section #1 downstream of the reservoir

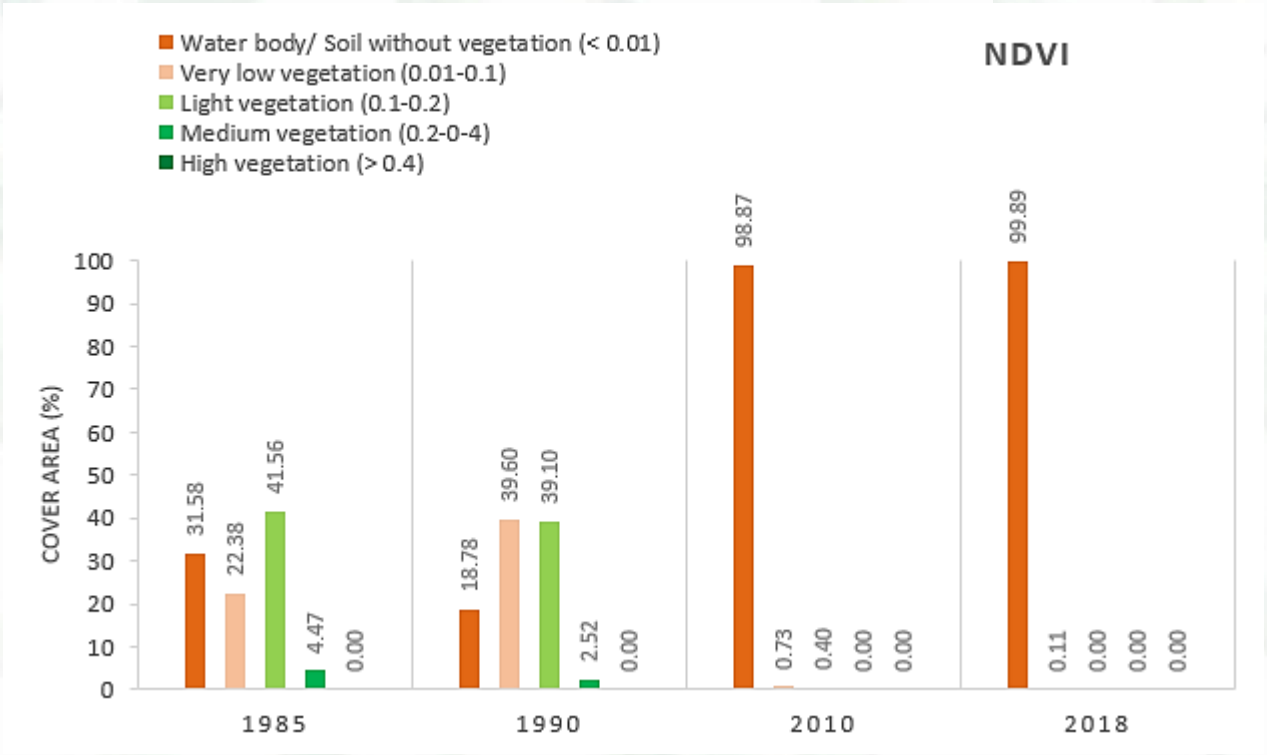


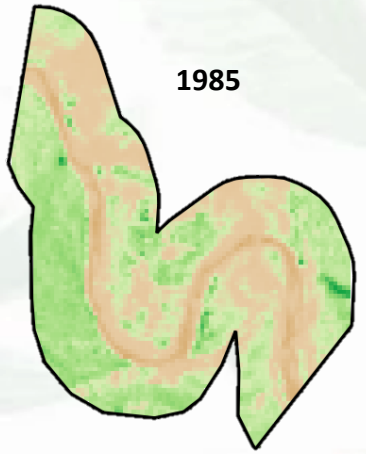


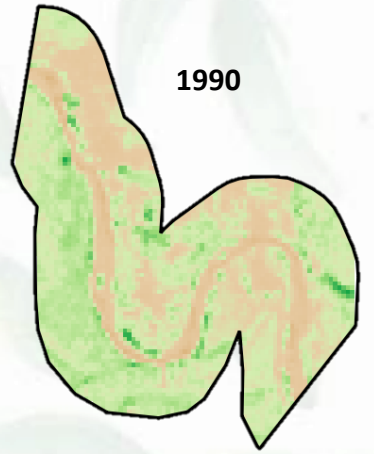


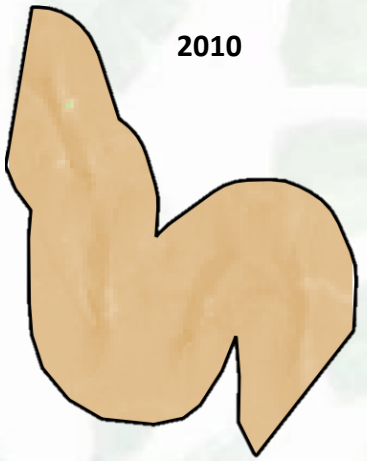
1990 IMAGE

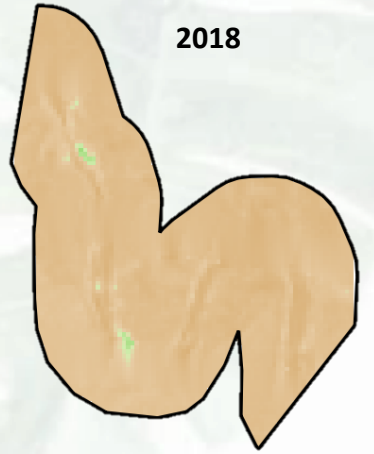
Section #2 downstream of the reservoir

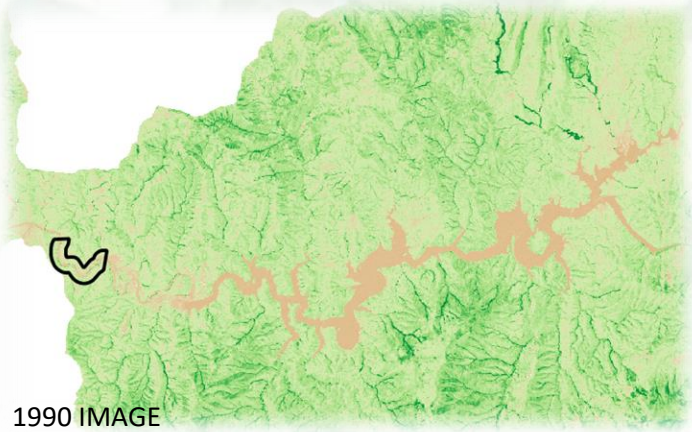






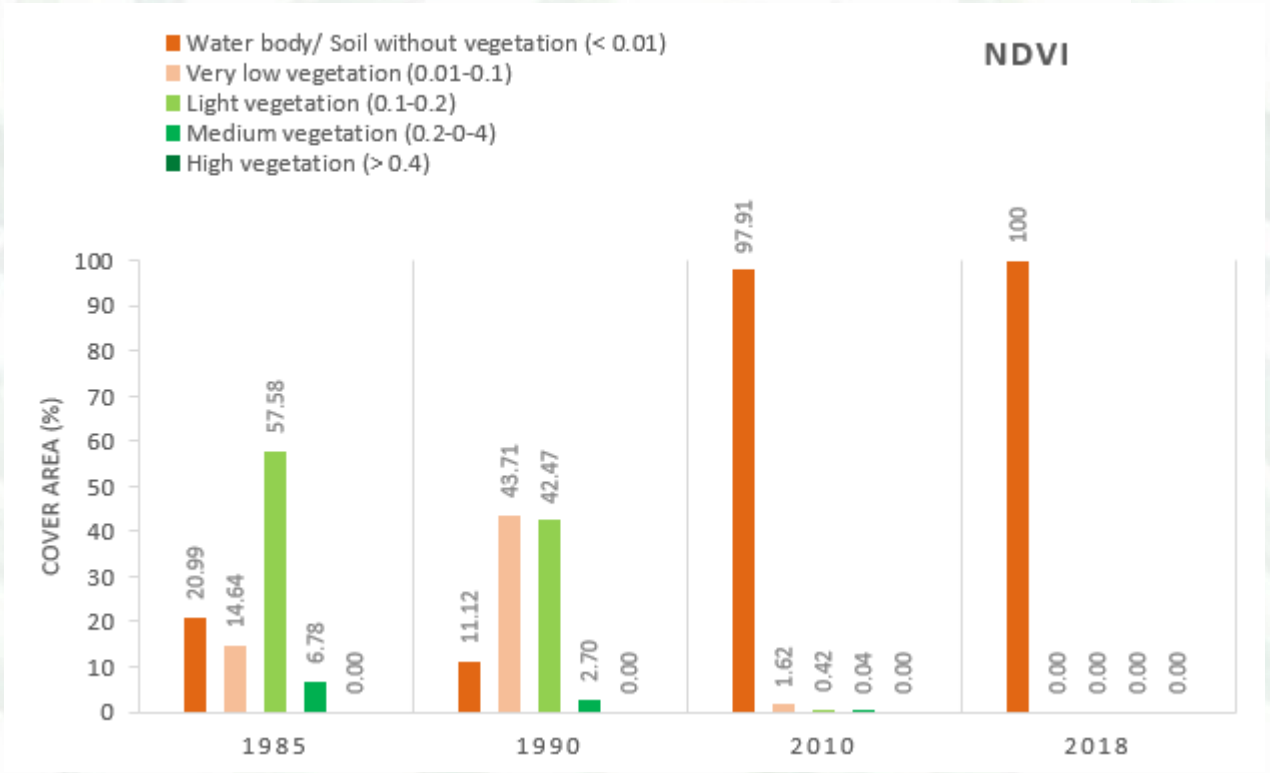


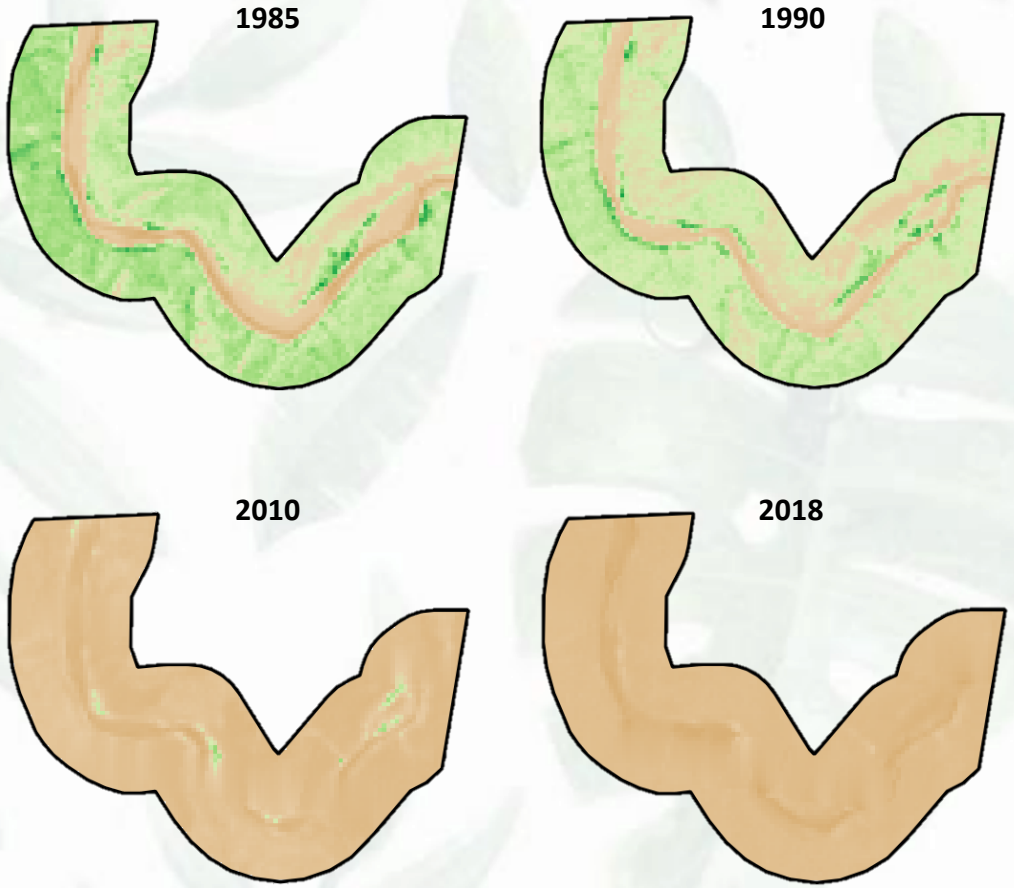


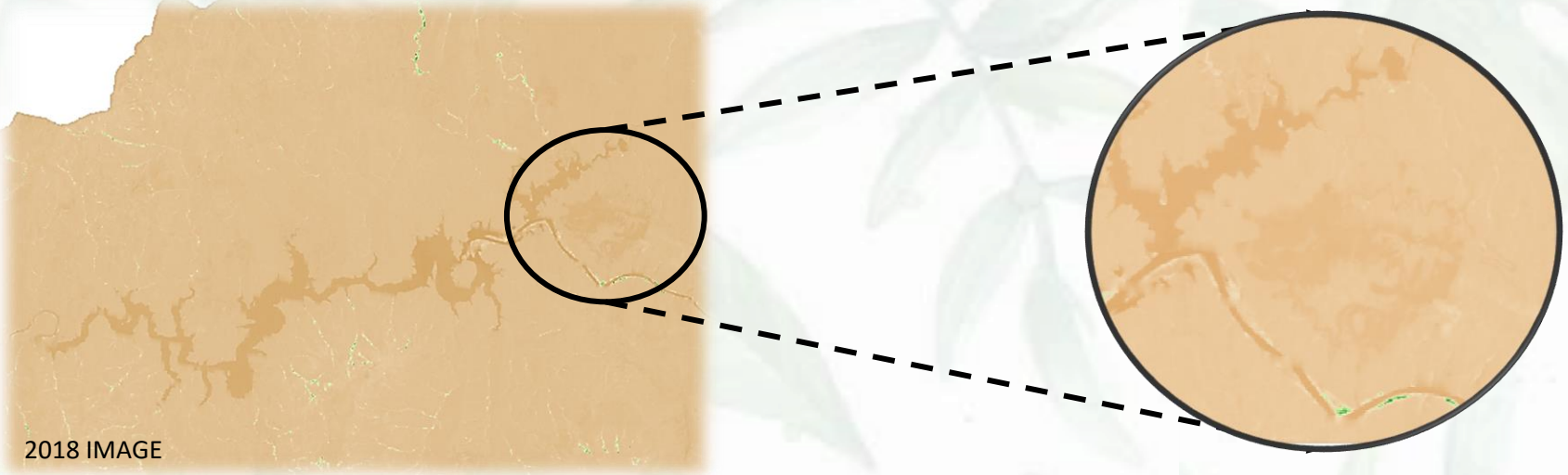


1990 IMAGE

Section #3 downstream of the reservoir







Mining activity

Figure 2. "El Limon" mine located upstream of the reservoir.

Since 2012 with the start of operations of the "El Limon" mine, the Canadian company Torex Gold Resources, located in Guerrero, is generating serious contamination from the chemical waste discharges it uses for the exploitation of gold and silver, which are dumped into the Balsas river and the “El Caracol” hydroelectric dam. There has been a decrease in the population of flora and fauna in the area. This is because the mine uses the cyanide leaching procedure to extract minerals, the remnants of which are directly discharged into the Balsas River.

The results show a decrease in NDVI in the study period. While degraded areas have a negative NDVI trend, there are areas within the same reservoir, where the index increases, indicating an increase in sediment deposition being an important factor in explaining vegetation migration.

The reduction in the capacity of mobilization of the sediment by the flow can intensify the establishment of riparian vegetation helping to stabilize the margins, which means that the channel is narrowing.

As the width of the river decreases due to sediment deposition, it can be observed that the riparian vegetation increases in these sections.

It can be seen that upstream of the reservoir there are areas where the riparian vegetation grows on the riverbanks from 1990 to 2010, but in recent images it is observed that due to the upstream mining activity, their contamination could have generated a loss in the vegetation.

Thanks for your attention!

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