

Supplemental information for:

Patterns and drivers of water quality changes associated with dams in the Tropical Andes

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Note: See Methods section of main paper for information on data accessibility at the Autoridad Nacional de Licencias Ambientales

Table S1. Summary of available data in samplings per year for assessing reservoir stratification (no. of profiles), changes to river temperature, dissolved oxygen and total suspended solids caused by dams for all hydropower stations licensed by the Autoridad Nacional de Licencias Ambientales (ANLA) in Colombia. Power plants with data for upstream versus downstream comparisons are listed first and sorted by surface area.

Powerplant	Watershed	Built	Reservoir		Profiles <i>n y</i> ⁻¹	Temp. up vs. downstream	DO	TSS pairs <i>y</i> ⁻¹
			<i>km</i> ²	<i>km</i> ³				
Quimbo	Magdalena-Cauca	2015	83.2	1.82	5	5	5	5
Urrea	Caribbean	2000	74.0	1.74	12	12	12	0
Sogamoso	Magdalena-Cauca	2015	70.0	4.80	0	2	2	4
Betania	Magdalena-Cauca	1984	68.9	1.97	2	2	2	1
Guatape	Magdalena-Cauca	1976	51.4	1.24	2	2	2	0
Prado	Magdalena-Cauca	1971	33.8	0.97	0	1	1	1
Calima	Pacific	1964	21.0	0.53	0	1	1	0
La Miel	Magdalena-Cauca	2002	13.6	0.57	6	6	6	6
Chivor	Orinoco	1976	12.0	0.76	3	3	3	3
Guavio	Orinoco	1989	13.3	1.04	0	3	3	3
Rio Grande	Magdalena-Cauca	1988	12.1	0.20	1	1	1	0
Porce II	Magdalena-Cauca	2001	8.9	0.14	2	2	2	2
Porce III	Magdalena-Cauca	2011	4.7	0.17	12	12	12	12
Playas*	Magdalena-Cauca	1986	4.4	-	2	2	2	0
Punchina	Magdalena-Cauca	1982	3.4	0.07	3	2	2	2
Ituango	Magdalena-Cauca	2018	38.1	1.63	0	0	0	0
Salvajina	Magdalena-Cauca	1985	22.1	0.76	0	0	0	0
San Lorenzo* [†]	Magdalena-Cauca	1988	10.7	-	3	NA	NA	0
Miraflores*	Magdalena-Cauca	1965	8.0	-	0	0	0	0
El Paraiso*	Magdalena-Cauca	1950	6.2	-	0	0	0	0
Anchicaya	Pacific	1952	1.4	0.05	0	0	0	0
San Francisco	Magdalena-Cauca	1969	0.8	0.01	0	0	0	0

*Reservoir volume not known

[†]Turbined discharge goes directly into Playas Reservoir, so there is no downstream river to compare in inflowing conditions.

Table S2. Summary of approximate maximum differences in temperature and dissolved oxygen (DO) between surface and deep waters as well as minimum deep water DO concentration for Colombia hydropower reservoirs. Qualitative stratification classification is based on these metrics with “strong” referring to sites with minimum DO ≤ 1.5 . Reservoirs bounded by boxes share a direct hydrologic connection. Data source: Autoridad Nacional de Licencias Ambientales

Reservoir	Stratification			
	ΔT °C	ΔDO mg/L	DO min.	class
La Miel	5	7	1.5	Strong
Chivor	3.5	2	5.5	Weak
Porce III	4	10	0.1	Strong
Porce II	3	7.5	0.1	Strong
Miraflores	unknown	unknown	unknown	unknown
Quimbo	6	7.5	0.5	Strong
Betania	5.5	4	1	Strong
Urta	5.5	7.5	0.1	Strong
Guavio	unknown	unknown	unknown	unknown
Punchina	3	1	6.5	Weak
Guatape	2.5	7	0.5	Strong
Playas	3	2	5.5	Weak
San Lorenzo	5	2.5	4.5	Weak
Prado	unknown	unknown	unknown	unknown
Sogamoso	unknown	unknown	unknown	unknown
Calima	unknown	unknown	unknown	unknown
Rio Grande	2	7	0.5	Strong
El Paraiso	unknown	unknown	unknown	unknown
Anchicaya	unknown	unknown	unknown	unknown
Ituango	unknown	unknown	unknown	unknown
Salvajina	unknown	unknown	unknown	unknown
San Francisco	unknown	unknown	unknown	unknown

Table S3. Summary of inflowing water conditions, reservoir characteristics, management modes and downstream conditions for eight selected Colombian hydropower projects.

Project	data n months	Inflows			Reservoir					Management			Downstream	
		max. BOD mg L ⁻¹	min. DO mg L ⁻¹	TSS range mg L ⁻¹	res. Time days	depth m	Fr. # -	Elev. masl	deep DO mg L ⁻¹	withdrawal	oxygenation	sediments	DO mg L ⁻¹	TSS range mg L ⁻¹
Urta	12	6.7	hypoxic (4-5)	<10.6 - 680	29	73	0.153	131	anoxic (<1)	fixed depth	none	<3	no data	
Quimbo	6	<3	oxic (>6)	26 - 660	56	151	0.111	577	anoxic (<1)	fixed depth	liquid O ₂	<4	<5 - 54	
Sogamoso	2-3	4.3	oxic (>5)	17 - 1608	565	190	0.004	181	anoxic (<1)	fixed depth	in review	<3	2.5 - 198	
Prado	1-3	13	oxic (>7)	20	97	90	0.044	361	no data	fixed depth	in review	<4	13.5 - 28	
Porce III	12	4.3	hypoxic (<4)	<5 - 32	8	151	0.170	680	anoxic (<1)	fixed depth	none	<5	8.9 - 62	
La Miel	6	<2	oxic (>7)	<6 - 149	78	188	0.022	327	hypoxic (<2)	fixed depth	integrated	>6.5	<6 - 19	
Chivor	3	9	oxic (>6)	37 - 265	255	237	0.006	1200	oxic (>5)	multi-intake	none	>7	<10	
Guavio	2-3	<3	oxic (>6)	22 - 419	168	243	0.006	1949	no data	fixed depth	none	>7	324 - 554	

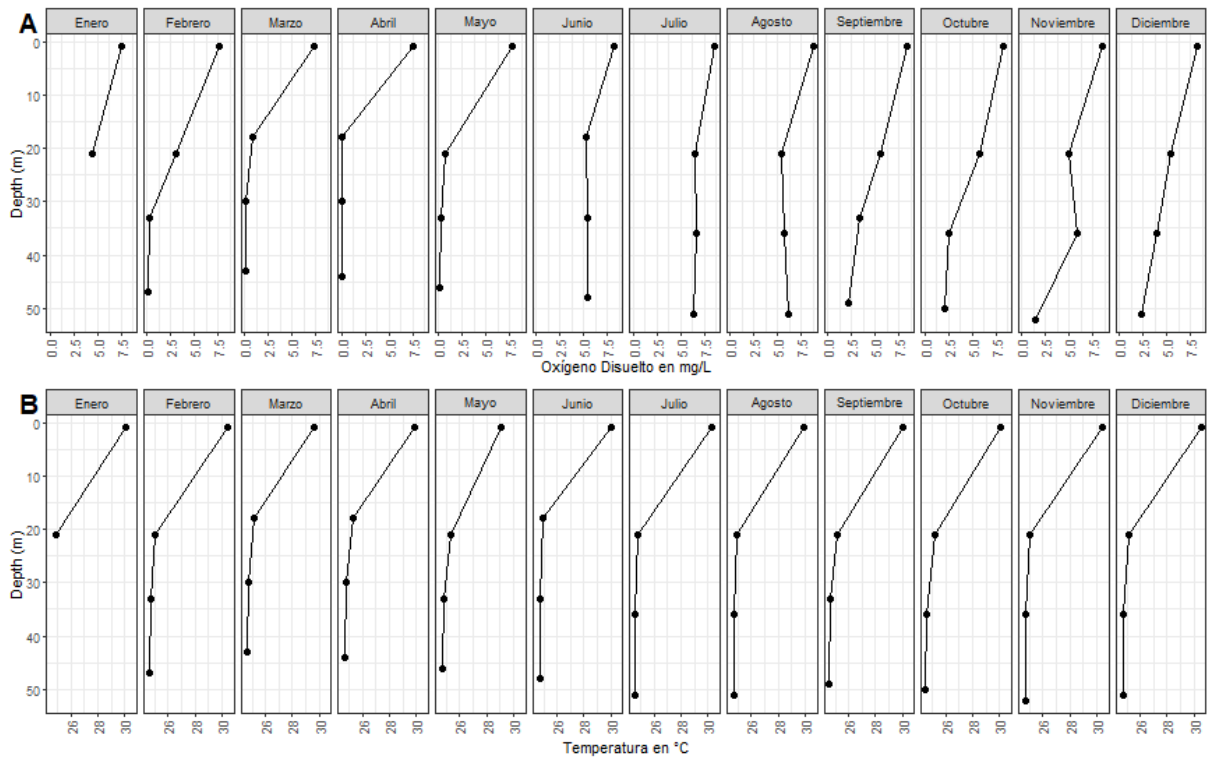


Fig. S1. Depth profiles of dissolved oxygen and temperature for Urra Reservoir in Cordoba, Colombia measured in 2018. Data source: Autoridad Nacional de Licencias Ambientales

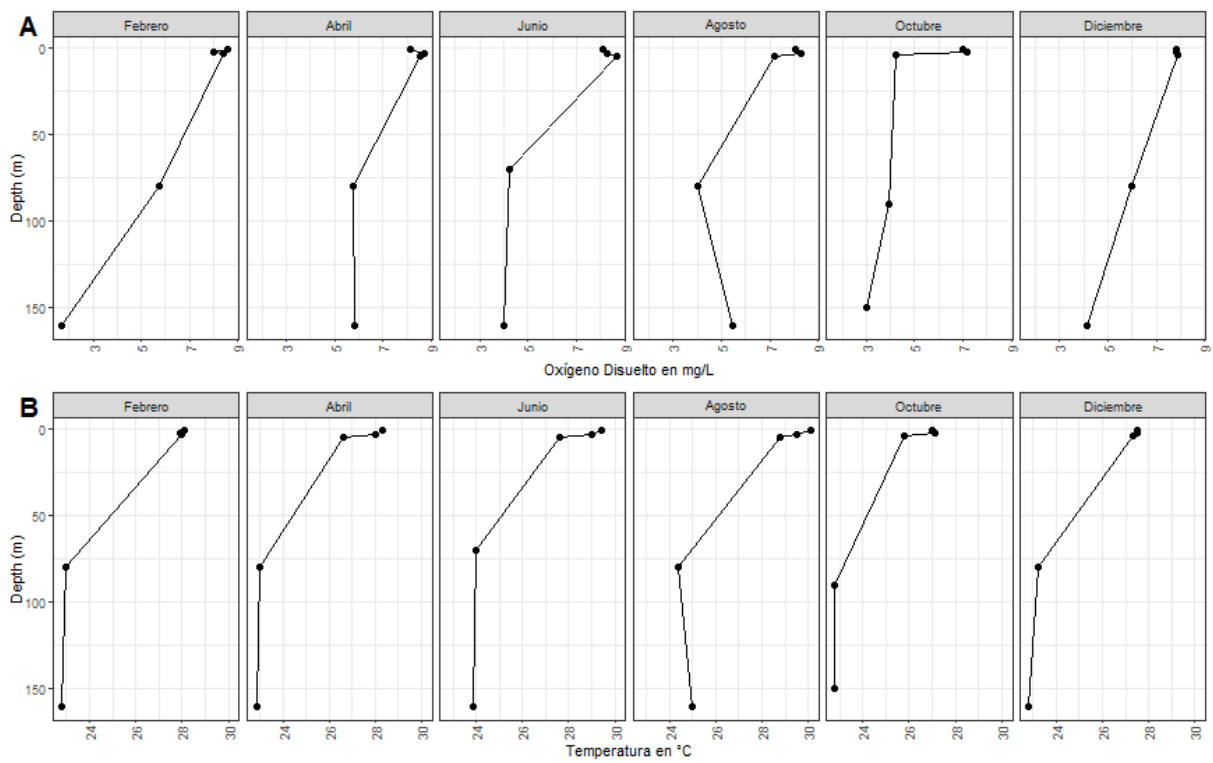


Fig. S2. Depth profiles of dissolved oxygen and temperature for La Miel Reservoir in Caldas, Colombia measured in 2018. Data source: Autoridad Nacional de Licencias Ambientales

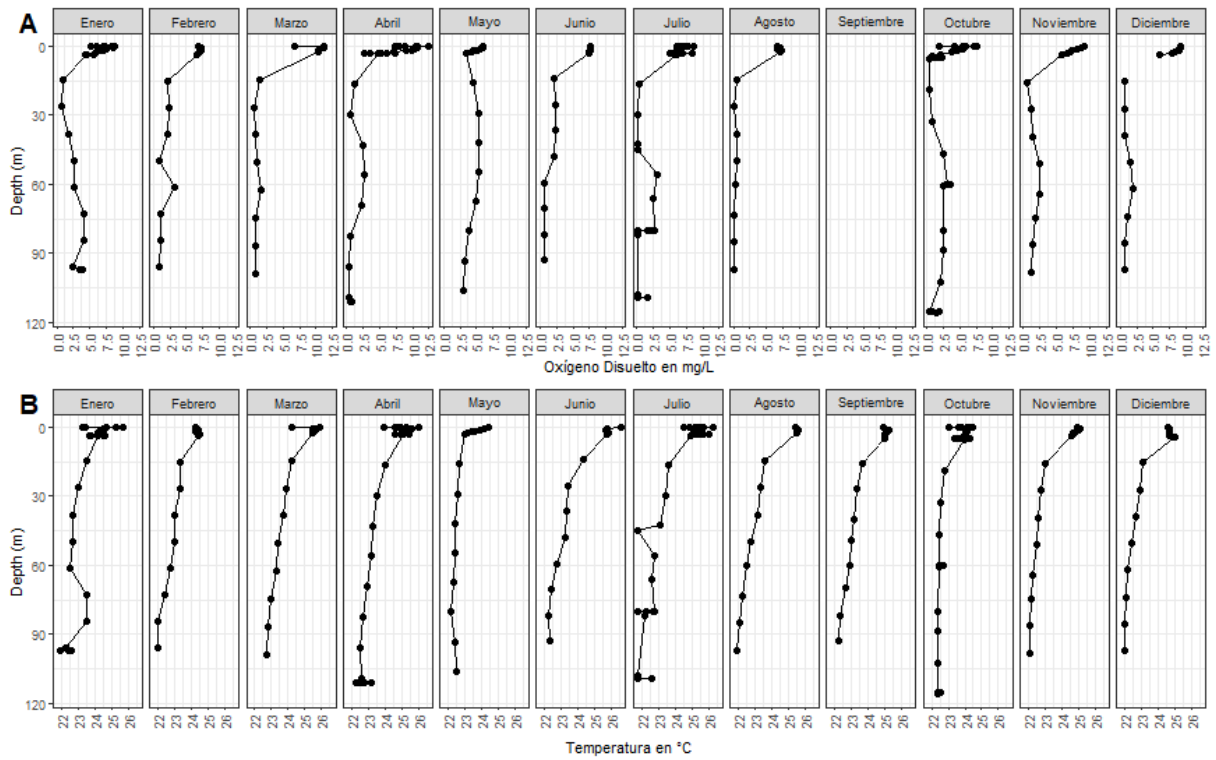


Fig. S3. Depth profiles of dissolved oxygen and temperature for Porc III Reservoir in Antioquia, Colombia measured in 2018. Data source: Autoridad Nacional de Licencias Ambientales