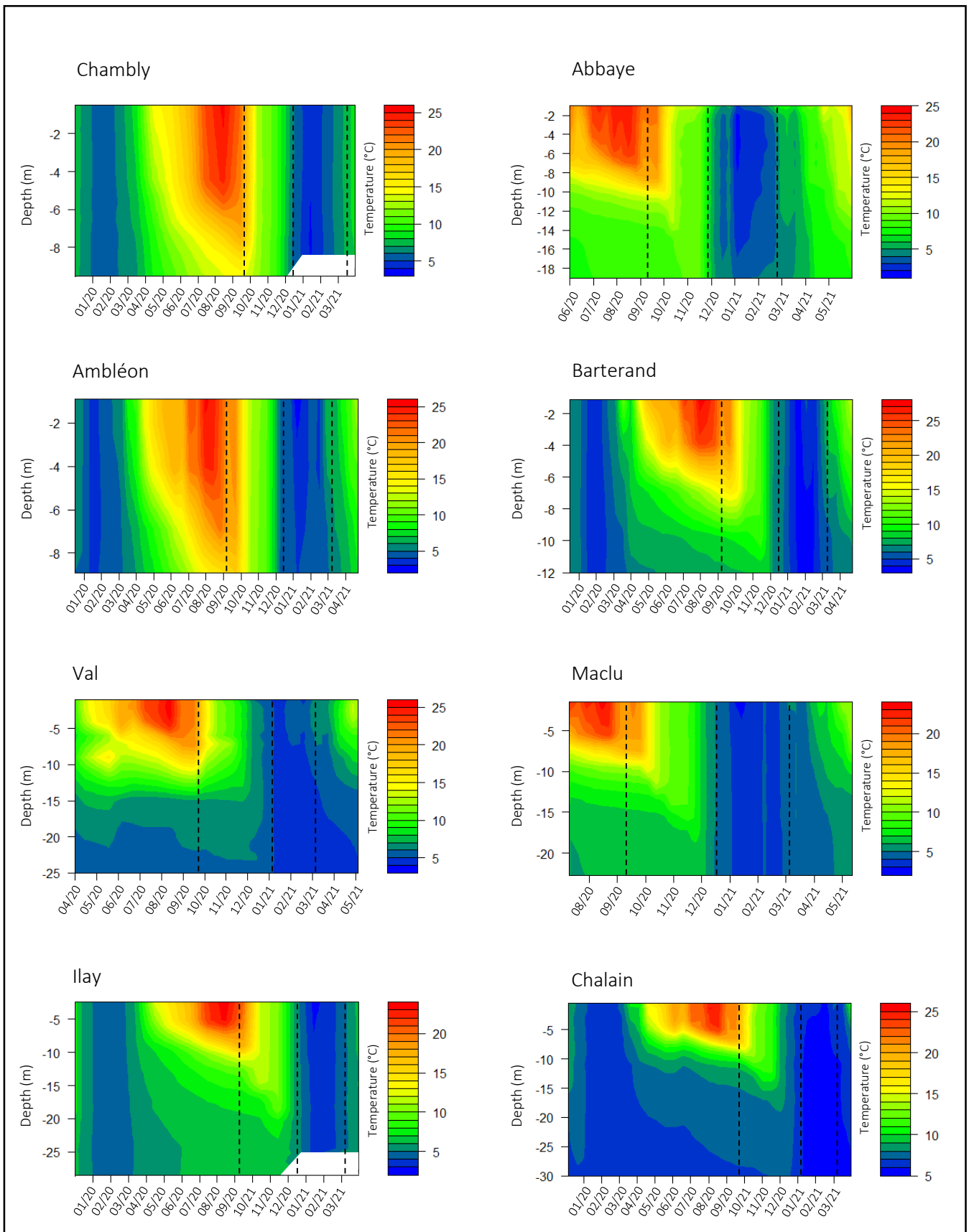
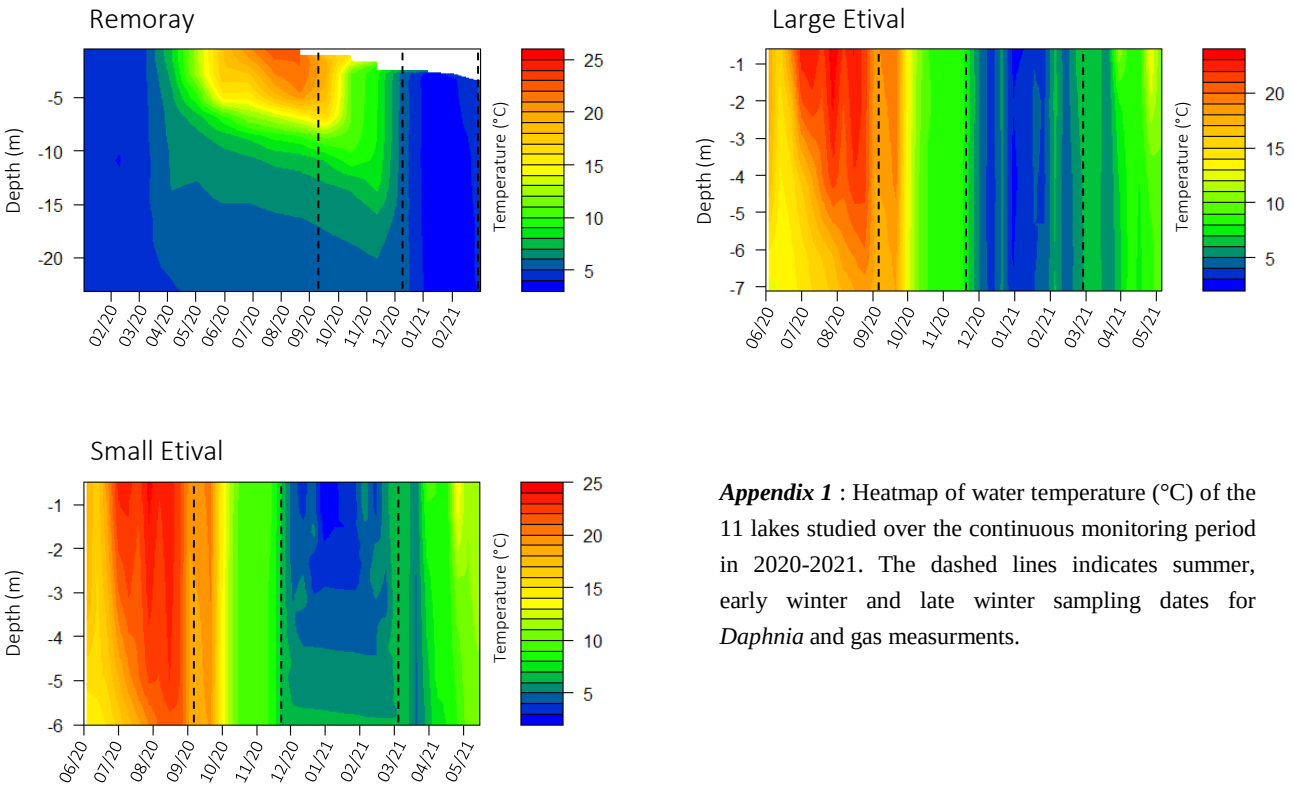
Supplementary material:



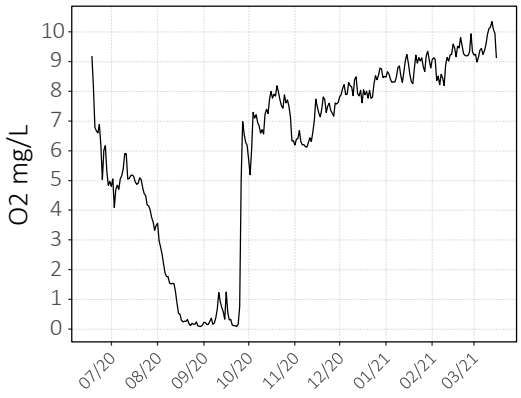


Appendix 1 : Heatmap of water temperature (°C) of the 11 lakes studied over the continuous monitoring period in 2020-2021. The dashed lines indicates summer, early winter and late winter sampling dates for *Daphnia* and gas measurments.

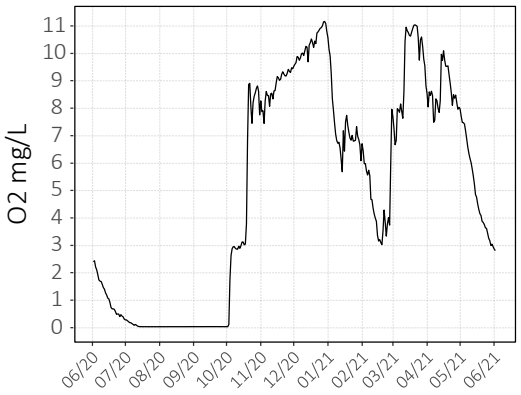
The lakes of Chambly, Abbaye, Ambleon, Barterand, Val, Maclu, Ilay, Chalain and Remoray were strongly thermally stratified during summer period with mean temperature differences between surface and bottom layer ($\Delta°C_{\text{stratification period}}$) ranging from 8.1 to 13.3°C depending on lakes. In contrast, lakes of small and large Etival were weekly stratified during summer period, with $\Delta°C_{\text{stratification period}}$ of respectively 3,1 and 4,7°C, and showed episodes of partial mixing of the water column during summer period.

The 11 lakes studied showed mixing of their water column between the end of September and the end of December depending on lakes. Lakes Etival, Ambleon and Chambly, which are the shallowest lakes of this study, were mixed relatively early compared to the other lakes studied, between late September and early October. The deepest lakes of th study like Chalain, Val, Ilay, or Remoray were mixed later in the season, between early and late December.

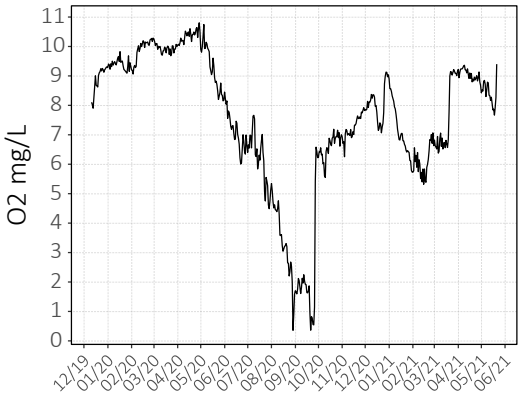
Chambly



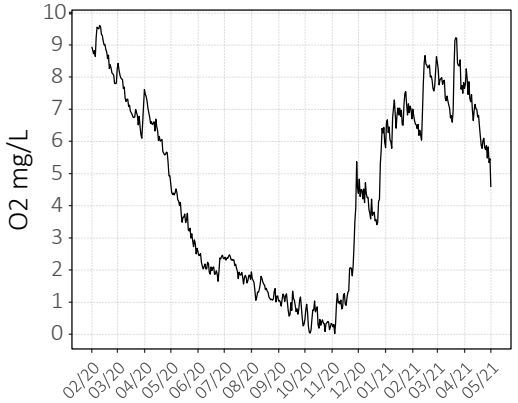
Abbaye



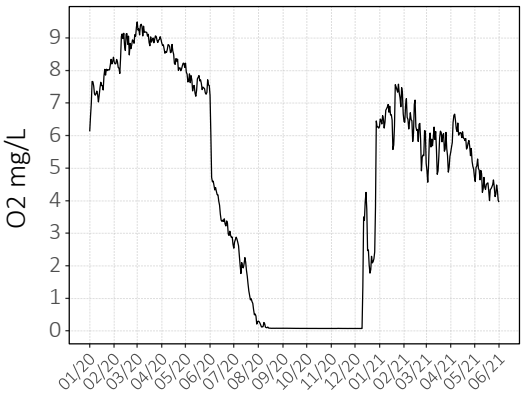
Ambléon



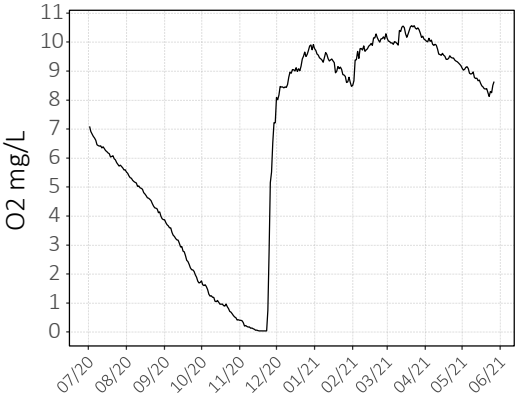
Barterand



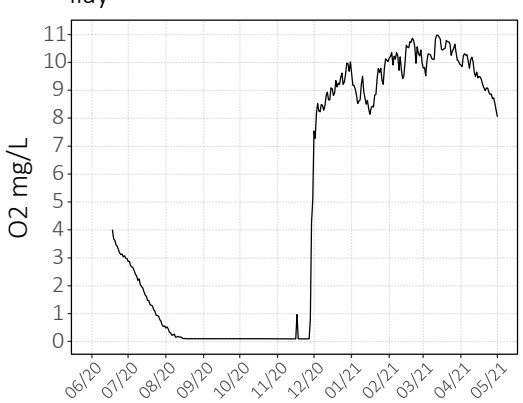
Val



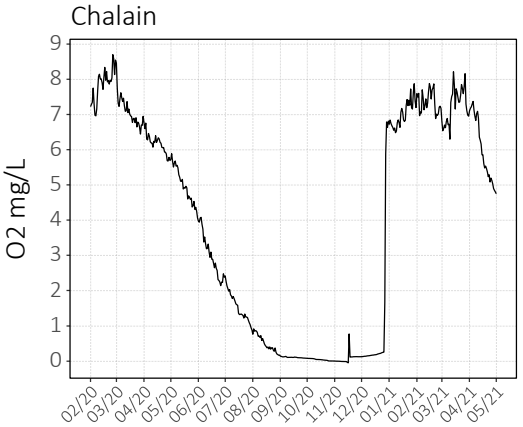
Maclu

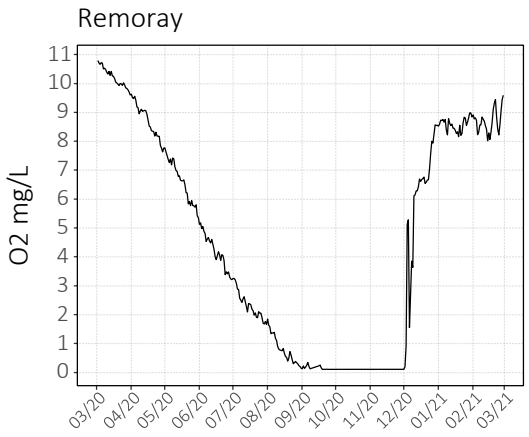


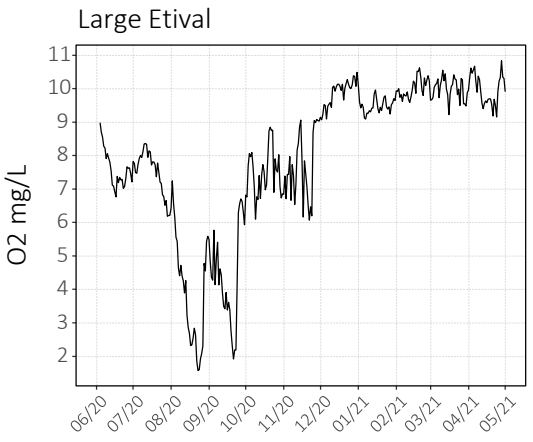
Ilay

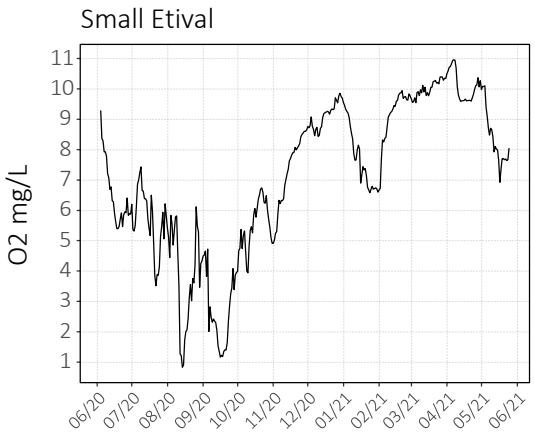


Chalain









Appendix 2 : Dissolved oxygen concentration at 0,8*Zmax over the continuous monitoring period in 2020-2021.

The lakes of Chambly, Abbaye, Ambleon, Barterand, Val, Maclu, Ilay, Chalain and Remoray, which were strongly stratified during summer period, showed intense deoxygenation at depth to reach total anoxia at 0,8*Zmax during stratification period. Both lakes of Etival, which were weakly stratified during summer period, showed deoxygenation of lower magnitude than the stratified lakes, with minimum oxygen concentration reaching 1mg/l for small Etival and 2mg/l for large Etival.

Hypoxia duration (days with $[O_2]$ below 2 mg/l at 0,8*Zmax) is variable depending on lakes, ranging from 5 to 175 days. Small and large Etival, which were weakly stratified during summer, showed small hypoxia duration of respectively 14 and 5 days. In strongly stratified lakes, hypoxia duration is nonetheless variable depending on lakes. Lakes Abbaye, Barterand, Chalain, Ilay, Remoray and Val showed prolonged periods of hypoxia ranging from 121 to 175 days. In contrast, the lakes of Ambleon, Chambly and Maclu, which were also strongly stratified during summer, showed less prolonged periods of hypoxia ranging from 23 to 60 days.

	Summer Zmax [CH4]aq		Summer Zmax [CO2]aq	
	p-value	*rho*	*p-value*	*rho*
C_{org}	0.65	-0.15	0.23	-0.39
C_{org}/N	0.81	0.08	0.16	0.45
$\delta^{13}C_{OM}$	0.4	-0.28	0.57	-0.19
TC	**2.2 e-16**	**0.96**	**4.2 e-4**	**0.89**
Hypoxia duration	0.46	0.24	0.21	0.4
$\Delta°C_{\text{ stratification period}}$	0.21	0.4	0.13	0.48
Relative agricultural area	**0.004**	**0.8**	**0.006**	**0.79**
Relative forest area	0.14	0.47	0.11	0.51

Appendix 3 : Spearman rank correlation test performed between lake properties and gas concentrations dataset. p-value and rho in bold type indicates significant relationship (α <0,05)

	Summer $\delta^{13}C_{Daphnia}$		Early winter $\delta^{13}C_{Daphnia}$		Late winter $\delta^{13}C_{Daphnia}$		seasonal $\Delta\delta^{13}C_{Daphnia}$		Mean seasonal $\Delta\delta^{13}C_{Daphnia}$	
	p-value	*rho*	*p-value*	*rho*	*p-value*	*rho*	*p-value*	*rho*	*p-value*	*rho*
Summer Zmax $[CH_4]aq$	0,11	0,5	0,13	-0,48	0,18	-0,43	**0,03**	**0,66**	**0,008**	**0,77**
Summer Zmax $[CO_2]aq$	0,31	0,33	**0,04**	**-0,62**	0,16	-0,45	**0,008**	**0,77**	**0,002**	**0,83**
Summer epilimnion $[CH_4]aq$	0,28	0,34	0,61	-0,17	0,63	-0,16	0,45	0,25	0,34	0,31
Summer epilimnion $[CO_2]aq$	0,12	-0,49	0,32	-0,32	0,17	-0,44	0,92	0,03	0,88	0,05
Early winter mean $[CH_4]aq$	0.98	0	0.45	-0.25	0.92	-0.03	0.53	0.2	0.67	0.14
Late winter mean $[CH_4]aq$	0.24	-0.38	0.4	-0.28	0.69	0.13	0.71	0.12	0.94	0.02
Early winter mean $[CO_2]aq$	0.43	-0.26	0.07	-0.57	**0.01**	**-0.71**	0.27	0.36	0.11	0.5
Late winter mean $[CO_2]aq$	0.59	0.18	0.35	-0.3	0.32	-0.32	0.15	0.46	0.04	0.61

Appendix 4 : Spearman rank correlation test performed between Daphnia carbon isotopic signatures and gas concentrations dataset. p-value and rho in bold type indicates significant relationship (α <0,05)

	Summer $\delta^{13}C_{Daphnia}$		Early winter $\delta^{13}C_{Daphnia}$		Late winter $\delta^{13}C_{Daphnia}$		Seasonal $\Delta\delta^{13}C_{Daphnia}$		Mean seasonal $\Delta\delta^{13}C_{Daphnia}$	
	p-value	*rho*	*p-value*	*rho*	*p-value*	*rho*	*p-value*	*rho*	*p-value*	*rho*
$\Delta°C_{\text{ stratification period}}$	0.52	0.21	0.09	-0.53	0.32	-0.32	**0.003**	**0.81**	**0.005**	**0.8**
Hypoxia duration	0.46	0.24	0.09	-0.53	0.5	-0.22	**0.007**	**0.78**	**0.01**	**0.7**
C_{org}	0.88	0.05	0.13	0.48	0.1	0.51	0.19	-0.42	0.16	-0.45
C_{org}/N	0.86	-0.06	0.08	-0.54	0.46	-0.24	0.06	0.58	0.07	0.52
$\delta^{13}C_{OM}$	0.53	0.2	0.73	0.11	0.28	0.35	0.69	0.13	0.88	0.05
TC	0.13	0.48	0.1	-0.52	0.16	-0.45	**0.01**	**0.74**	**0.001**	**0.86**
Relative agricultural area	0.71	0.12	**0.03**	**-0.64**	**0.02**	**-0.7**	**0.04**	**0.62**	**0.02**	**0.69**
Relative forest area	0.79	0.09	0.28	-0.35	0.38	-0.29	0.59	0.18	0.38	0.29

Appendix 5 : Spearman rank correlation test performed between Daphnia carbon isotopic signatures and lake properties. p-value and rho in bold type indicates significant relationship (α <0,05)