Supplementary information 1. Physical characteristics of the study sites.

Site	Altitude (m a.s.l.)	UTM X	UTM Y	Stream Order	Channel slope ($^0/_{00}$)	Channel width (m)	Average Temperature (°C)	Temperature CV	Turbidity (NTU)	Pfankuch	1/Pfankuch	Glaciality Index
1	4109	811078	9943872	1	3.76	0.95	7.38	0.3259	284	23	0.0429	0.3282
2	4195	811725	9945452	1	5.60	0.66	6.81	0.4178	144	22	0.0449	0.2968
3	4093	809927	9944126	2	3.00	0.88	8.07	0.2499	92	26	0.0382	0.2868
4	4105	811025	9943792	2	6.25	0.82	8.25	0.3684	103	25	0.0405	0.2839
5	4193	811710	9945398	2	5.20	0.91	7.04	0.2947	131	32	0.0313	0.2769
6	4056	809793	9943234	2	6.38	1.00	8.75	0.1593	62	34	0.0294	0.2692
7	4042	809888	9943190	2	0.09	1.46	9.05	0.1483	95	28	0.0357	0.2678
8	4039	809661	9943130	3	5.38	2.50	8.08	0.2278	60	37	0.0270	0.2597
9	4095	809877	9944066	2	3.00	0.87	8.65	0.1356	32	25	0.0400	0.2565
10	4093	810941	9943760	2	2.00	1.15	8.15	0.2648	40	25	0.0397	0.2551
11	4050	809793	9943234	2	2.52	1.50	7.84	0.0751	17	30	0.0333	0.2304
12	4090	809890	9944154	1	6.00	3.98	9.29	0.0479	10	40	0.0248	0.2023
13	4108	811088	9943738	1	3.08	0.80	8.05	0.1876	6	38	0.0260	0.1740
14	4101	811098	9943836	1	4.28	0.65	9.87	0.2603	7	42	0.0240	0.1719
15	4202	811707	9945446	1	38.75	0.56	8.44	0.2167	4	33	0.0299	0.1616
16	4045	809920	9943440	1	0.38	0.56	6.78	0.1056	3	34	0.0294	0.1598
17	4050	809919	9943238	1	0.27	3.56	7.08	0.0002	1	39	0.0256	0.1292

Supplementary information 2. Chemical and hydrological characteristics of the study sites.

Site	pH	Conductivity (µS/cm)	O2 Saturation (%)	O2 Concentration (mg/l)	Discharge (l/s)	Average Vel. (m/s)	Maximum Vel. (m/s)	Minimum Vel. (m/s)	Depth (cm)	Depth CV
1	7.31	12.2	102	7.24	15.3	0.196	0.323	0.032	16.89	0.00114
2	7.39	15.2	97	6.51	149.5	0.528	1.000	0.086	23.76	0.00129
3	6.93	37.2	103	7.53	35.1	0.235	0.382	0.067	23.82	0.00091
4	7.42	149.8	125	8.94	9.7	0.251	0.444	0.065	27.43	0.00078
5	7.67	24.6	112	7.64	31.1	0.148	0.308	0.038	23.77	0.00103
6	7.85	92.0	105	7.91	18.9	0.400	0.733	0.093	19.47	0.00106
7	7.89	100.5	110	8.07	5.9	0.505	1.250	0.165	18.29	0.00127
8	7.42	100.5	116	8.40	51.2	0.686	1.167	0.118	25.66	0.00104
9	6.84	112.9	111	7.68	122.8	0.323	0.590	0.075	24.08	0.00088
10	7.43	98.4	115	8.30	27.3	0.436	0.774	0.130	22.32	0.00098
11	7.01	93.0	109	8.25	31.9	0.533	1.200	0.068	25.11	0.00106
12	6.74	147.1	155	10.52	10.0	0.205	0.422	0.045	25.26	0.00074
13	7.14	81.5	105	7.46	17.5	0.371	0.625	0.091	21.48	0.00102
14	7.40	214.4	130	8.61	4.4	0.179	0.323	0.059	19.15	0.00114
15	8.05	58.6	116	8.41	1.3	0.062	0.153	0.007	30.28	0.00105
16	8.08	154.0	124	8.90	1.5	0.333	0.729	0.058	11.09	0.00104
17	6.51	140.6	106	8.01	3.7	0.313	0.714	0.063	38.38	0.00105

Supplementary information 3. Loadings of the variables for the 1st and 2nd axes of the non-centered PCA for the glaciality index, GI.

Variables	1st Axis	2nd Axis
% Variance explained by each axis	0.82	0.15
Turbidity	0.92	0.37
Conductivity	-0.36	0.92
Temperature CV	0.11	-0.05
1/Pfankuch	0.09	-0.09
Depth CV	$3.50E^{-05}$	0.00

Supplementary information 4. Macroinvertebrate abundance and functional feeding group (FFG) clustering from benthic samples (individuals m^{-2}).

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Sum	Average	%
Alluaudomyia sp.	52	692	668	120	1476	980	28	84	104	216	8	0	84	12	20	12	0	4556	268	3.79
Hemerodromia sp.	0	0	0	0	0	0	4	0	0	0	0	0	0	0	20	0	0	24	1	0.02
Predators/Scrapers	52	692	668	120	1476	980	32	84	104	216	8	0	84	12	40	12	0	4580	269	3.8
Atopsyche sp.	16	36	52	24	28	32	20	0	0	28	20	0	36	12	144	4	80	532	31	0.44
Cailloma sp.	24	12	180	0	12	0	60	16	4	8	56	0	72	0	28	4	8	484	28	0.4
Predators/Collectors	40	48	232	24	40	32	80	16	4	36	76	0	108	12	172	8	88	1016	60	0.8
Hirudinea	0	0	0	0	4	0	4	40	0	8	0	4	0	44	192	4	0	300	18	0.25
Limnophora sp.	4	8	64	0	4	0	4	0	8	24	4	8	4	56	0	32	0	220	13	0.18
Chelifera sp.	0	12	128	12	56	4	136	76	16	4	124	12	52	0	0	20	96	748	44	0.62
Planariidae	16	84	12	280	32	104	8	8	16	484	72	92	544	212	4	396	640	3004	177	2.5
Nematoda	20	0	4	4	0	8	44	0	8	4	8	0	12	4	20	8	8	152	9	0.13
Predators	40	104	208	296	96	116	196	124	48	524	208	116	612	316	216	460	744	4424	260	3.7
Andesiops sp.	68	660	5236	208	756	4584	700	892	1416	448	2744	2072	1740	388	112	692	4340	27056	1592	22.49
Blepharicera sp.	0	0	8	4	0	24	44	116	0	52	0	0	4	0	0	0	0	252	15	0.21
Mortoniella sp.	4	0	0	8	0	20	1108	112	8	0	56	8	572	28	0	56	0	1980	116	1.65
Molophilus sp.	0	0	480	0	8	116	28	40	104	24	4	4	92	0	0	40	0	940	55	0.78
Scrapers	72	660	5724	220	764	4744	1880	1160	1528	524	2804	2084	2408	416	112	788	4340	30228	1778	25.1
Hyallela sp.	0	8	56	2100	36	44	144	180	260	1004	128	6484	1144	15972	1896	1400	596	31452	1850	26.14
Neoelmis sp. (L)	0	0	0	0	4	0	4	40	0	8	0	4	0	48	192	4	0	304	18	0.25
Shredders/Scrapers	0	8	56	2100	40	44	148	220	260	1012	128	6488	1144	16020	2088	1404	596	31756	1868	26.4
Neotrichia sp.	0	0	0	28	0	0	12	24	4	92	324	0	68	0	0	72	28	652	38	0.54
Ochrotrichia sp.	0	0	0	24	0	0	12	240	0	336	324	0	352	0	0	72	28	1388	82	1.15
Claudioperla sp.	0	12	104	4	64	236	4	0	16	12	16	0	4	0	0	4	12	488	29	0.41
Anomalocosmoecus sp.	0	0	44	0	0	0	488	360	16	112	412	764	1832	0	0	904	1460	6392	376	5.31
Shredders	0	12	148	56	64	236	516	624	36	552	1076	764	2256	0	0	1052	1528	8920	525	7.4
Scirtes sp.	4	28	48	40	20	108	20	64	84	76	0	16	0	0	48	4	0	560	33	0.47
Neoelmis sp. (A)	0	0	0	0	8	0	8	80	0	16	0	8	0	92	384	8	0	604	36	0.5
Shredders/Collectors	4	28	48	40	28	108	28	144	84	92	0	24	0	92	432	12	0	1164	68	1
Naididae	38	47	91	40	50	58	26	243	53	50	65	72	81	67	68	29	32	1110	65	0.92
Lumbriculidae	28	668	96	28	532	416	20	132	240	8	24	20	16	200	296	24	32	2780	164	2.31
Chironomidae	732	536	4544	300	1328	3476	2812	2940	1376	1780	1692	1156	992	140	2416	2872	2184	31276	1840	25.98
Collectors/Scrapers	798	1251	4731	368	1910	3950	2858	3315	1669	1838	1781	1248	1089	407	2780	2925	2248	35166	2069	29.2
Sphaeriidae	0	0	0	0	4	0	12	0	0	0	8	12	8	4	0	8	0	56	3	0.05
Ostracoda	0	0	0	20	8	0	0	12	8	24	20	116	24	104	384	0	0	720	42	0.6
Simulium sp.	124	240	316	44	196	404	80	72	116	12	96	104	4	132	52	304	0	2296	135	1.91
Collectors	124	240	316	64	208	404	92	84	124	36	124	232	36	240	436	312	0	3072	181	2.6

Supplementary information 5. Macroinvertebrate a) gut contents analysis and b) referential diet composition (%).

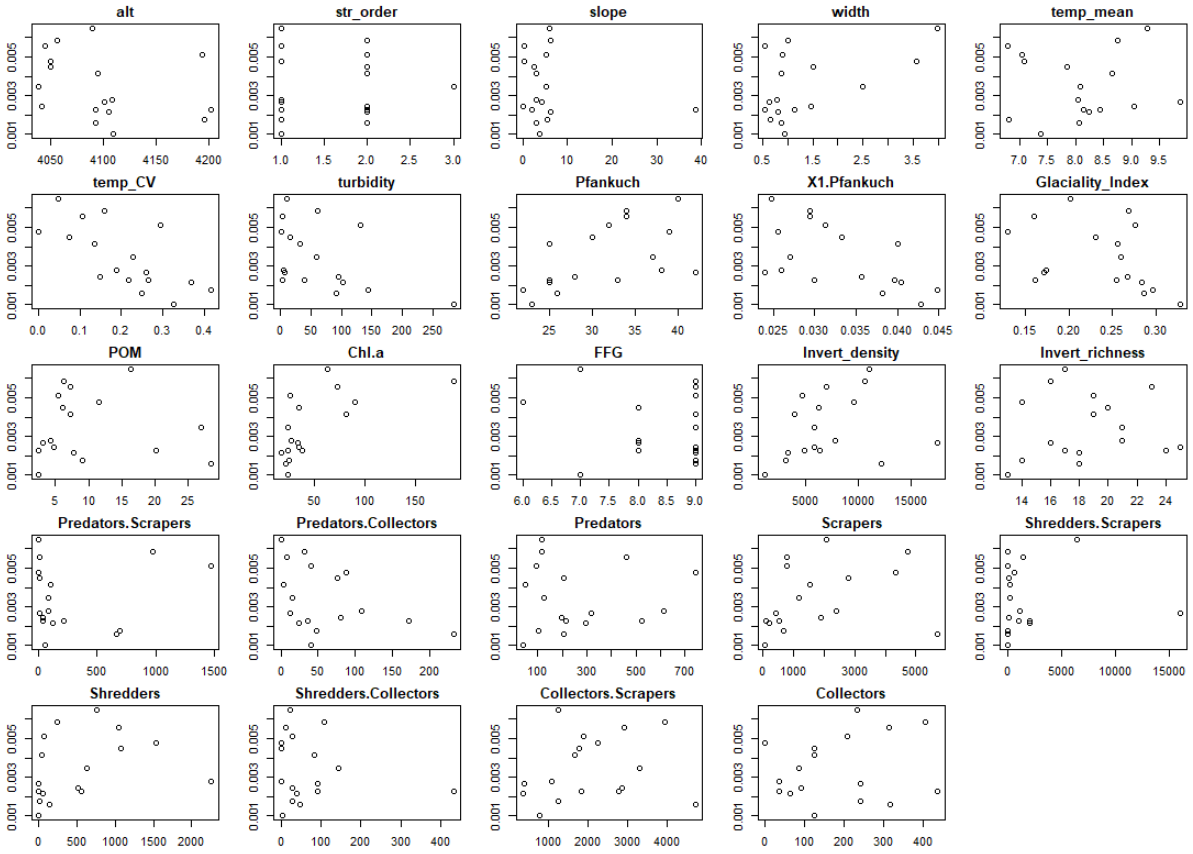
	FFG	Filamentous algae	Diatoms	Coarse Detritus	Fine Detritus	Animal Parts
a) Gut Content Analysis						
Elmidae sp. larvae	Shredders/Scrapers	17	15	51	17	0
Elmidae sp. adult	Shredders/Collectors	9	6	41	44	0
Scirtes sp.	Shredders/Collectors	16	5	32	47	0
Blepharicera sp.	Scrapers	16	42	10	32	0
Molophilus sp.	Scrapers	10	33	38	19	0
Andesiops sp.	Scrapers	20	33	15	32	0
Claudioperla sp.	Shredders	24	15	38	19	4
Mortoniella sp.	Scrapers	20	33	20	27	0
Neotrichia sp.	Shredders	32	15	45	8	0
Ochrotrichia sp.	Shredders	28	15	48	9	0
Anomalocosmoecus sp.	Shredders	37	6	38	10	9
Hyallela sp.	Shredders/Scrapers	15	5	52	28	0
b) Referential Diet						
Sphaeriidae	Collectors	0	0	0	100	0
Naididae	Collectors/Scrapers	0	0	20	80	0
Lumbriculidae	Collectors/Scrapers	0	0	20	80	0
Hirudinea	Predators	0	0	0	0	100
Alluaudomyia sp.	Predators/Scrapers	0	18	0	32	50
Chironomidae	Collectors/Scrapers	0	16	3	78	3
Chelifera sp.	Predators	0	0	0	0	100
Hemerodromia sp.	Predators/Scrapers	0	16	0	44	50
Limnophora sp.	Predators	0	0	0	0	100
Simulium sp.	Collectors	0	3	6	91	0
Atopsyche sp.	Predators/Collectors	0	3	0	23	74
Cailloma sp.	Predators/Collectors	0	3	0	23	74
Ostracoda	Collectors	0	0	0	100	0
Planariidae	Predators	0	0	0	0	100
Nematoda	Predators	0	0	0	0	100

Supplementary information 6. Mean daily decomposition rates of *Calamagrostis* in fine mesh bags (k_{FM}) and coarse mesh bags (k_{CM}).

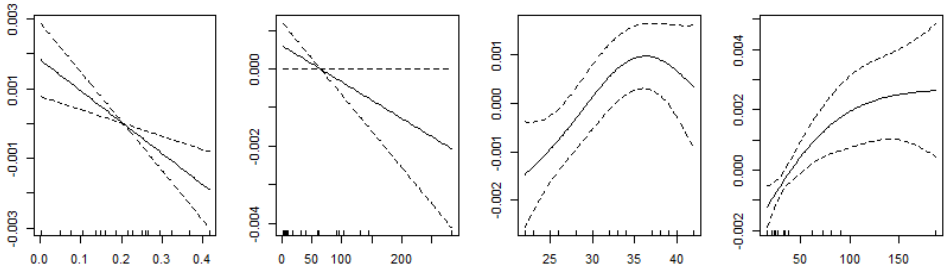
Site	k_{FM}	k_{CM}	k_{CM}-k_{FM}
1	0.001002902	0.002598214	0.001595312
2	0.001784377	0.001915982	0.000131605
3	0.001598868	0.002050305	0.000451437
4	0.002181538	0.00434769	0.002166152
5	0.005139774	0.006053096	0.000913323
6	0.005859977	0.006183782	0.000323805
7	0.002422589	0.004878257	0.002455669
8	0.003476249	0.007074116	0.003597867
9	0.004172887	0.00685946	0.002686573
10	0.002290155	0.003991866	0.001701711
11	0.004472835	0.004812176	0.000339341
12	0.006494029	0.008790632	0.002296604
13	0.00278253	0.003932682	0.001150152
14	0.002673939	0.004166445	0.001492505
15	0.002296551	0.00450012	0.002203569
16	0.005556425	0.006522074	0.000965649
17	0.004776378	0.00510959	0.000333212

Supplementary information 7. Results of GAMs

Decomposition rates in fine mesh bags (K_{FM})



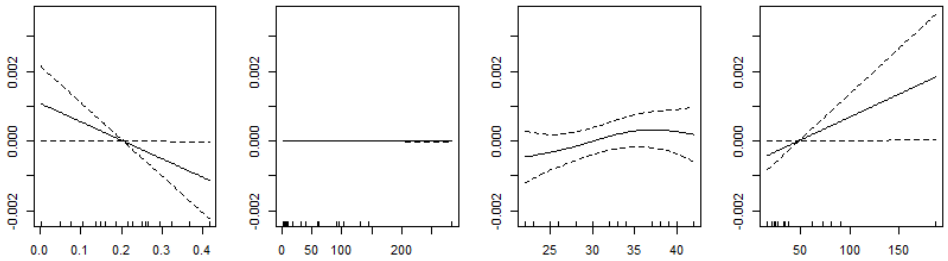
One model for each indepent variable; four proved significant:



Temp CV	Turbidity	Pfankuch	Chl. *a*

	Edf	F	p-value
Temp CV	0.8838	4.03	0.00198
Turbidity	0.849	1.35	0.0448
Pfankuch	1.474	2.82	0.0147
Chl. *a*	1.805	5.228	0.00288

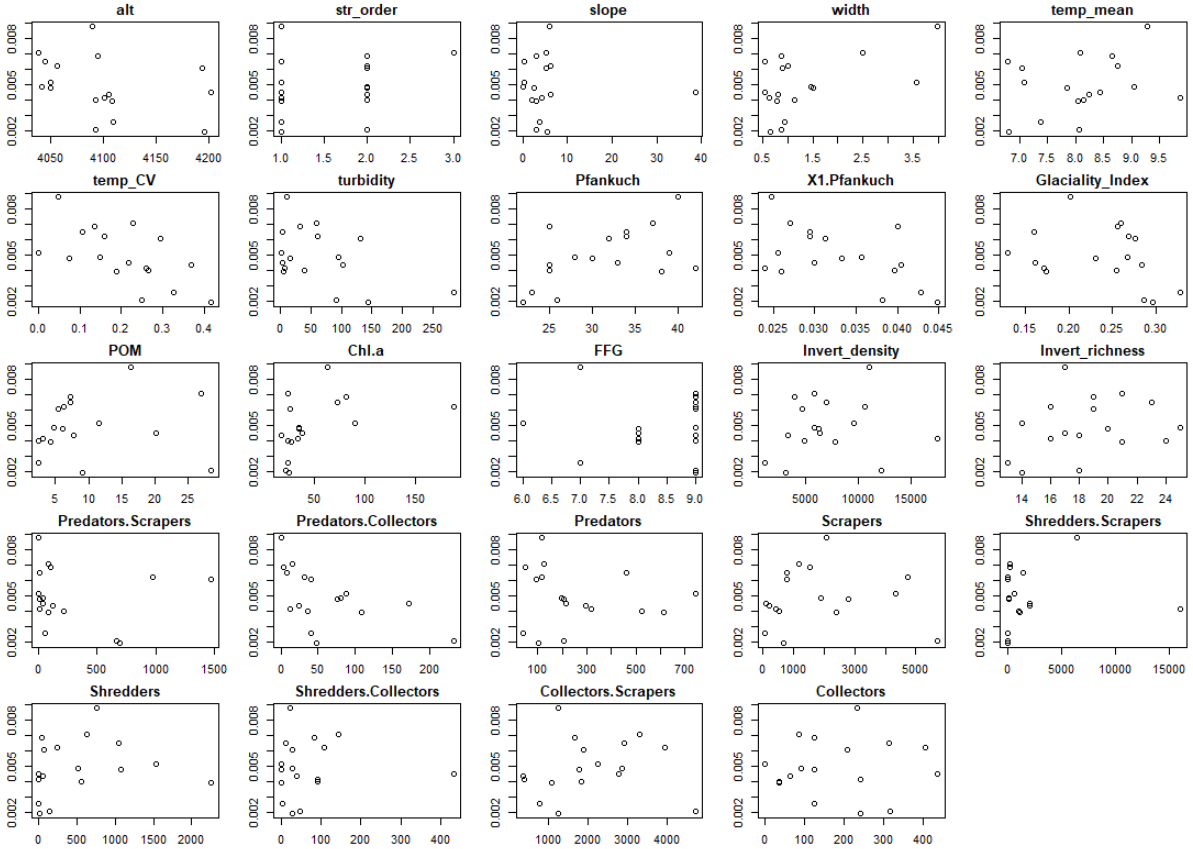
The model including the four above significant variables :



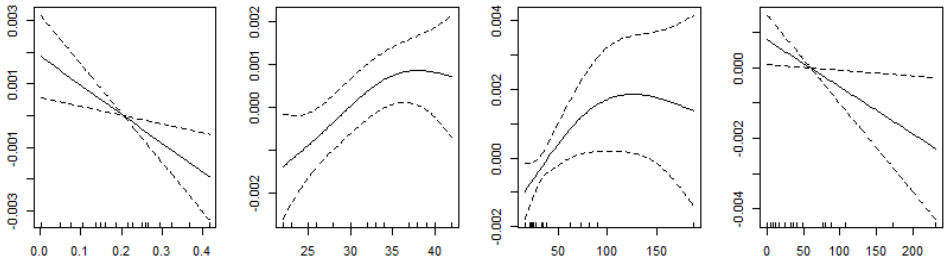
Temp CV	Turbidity	Pfankuch	Chl. *a*

	Edf	F	p-value
Temp CV	8.065e-01	1.384	**0.0310**
Turbidity	7.538e-05	0.000	0.5944
Pfankuch	8.442e-01	0.554	0.1672
Chl. *a*	8.063e-01	1.387	**0.0364**

Decomposition rates in fine mesh bags (K_{CM})



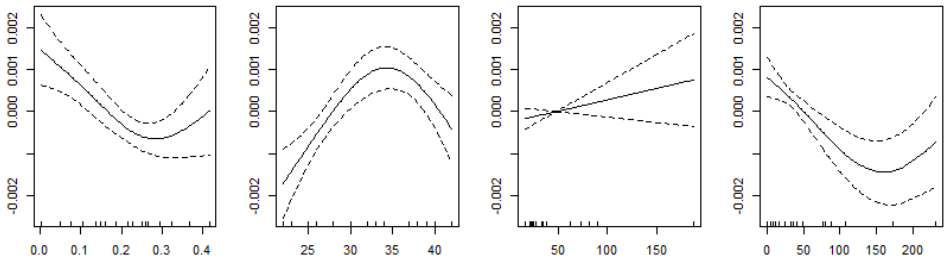
One model for each indepent variable; four proved significant:



Temp CV	Pfankuch	Chl. *a*	Predators/Collectors

	Edf	F	p-value
Temp CV	0.9176	2.753	0.0087
Pfankuch	1.264	1.956	0.0284
Chl. *a*	1.611	2.05	0.045
Predators/Collectors	0.8395	1.725	0.0249

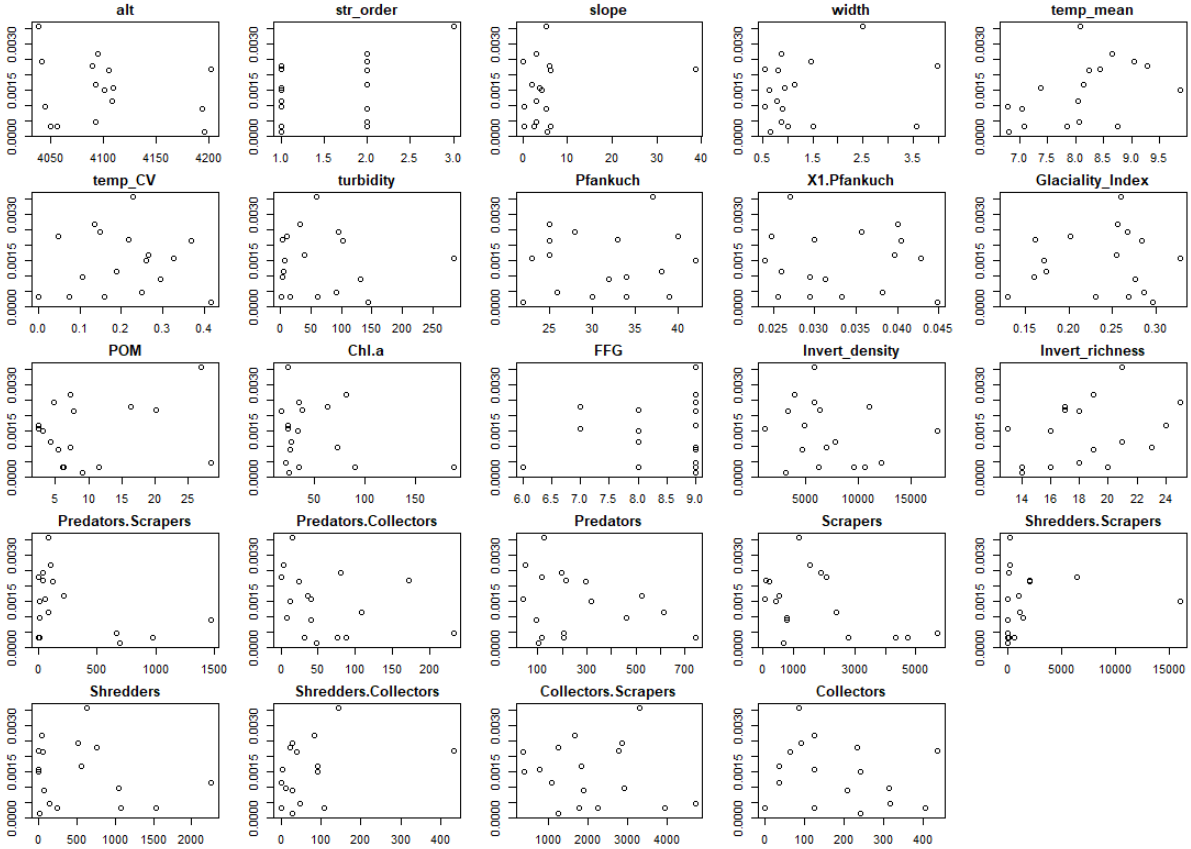
The model including the four above significant variables :



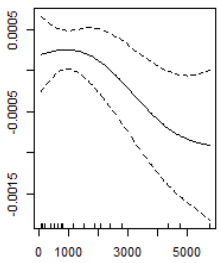
Temp CV	Pfankuch	Chl. *a*	Predators/Collectors

	Edf	F	p-value
Temp CV	1.6909	4.369	**0.00681**
Pfankuch	1.8225	5.886	**0.00335**
Chl. *a*	0.6487	0.616	0.11592
Predators/Collectors	1.7251	5.224	**0.00452**

Difference coarse-fine mesh bags (K_{CM}-K_{FM})



One model for each indepent variable; one proved significant:



Scrapers

	Edf	F	p-value
Scrapers	1.206	1.553	0.0457