Supplementary material A: Study area

Water chemistry

Table S1: Water chemistry of the streams sampled monthly from February 2002 until April 2003, and analyzed according to NEN-EN-ISO/IEC 17025 (N = 17). Mean daily water temperature per northern meteorological season based on 15 minute measurements from April 2002 until April 2003 with an OTD-diver (Van Essen instruments, Delft, The Netherlands).

	Bunderbosbeek BU stream				Strabekervloedgraaf ST stream				Seelbeek SE stream				Oude beek OB stream			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
pH	7.2	0.1	7.0	7.4	7.3	0.2	7.0	7.5	6.9	0.2	6.7	7.5	7.0	0.1	6.8	7.3
EC (µS/cm)	702	108	522	896	558	90	437	735	342	48	226	438	193	11	168	209
Ca (mg/l)	98.0	8.5	83.2	112.0	77.9	6.3	64.8	90.0	33.0	2.5	30.0	38.7	18.0	2.7	8.4	21.1
Cl (mg/l)	51.0	3.2	42.5	55.8	26.2	2.6	18.3	29.4	25.5	2.6	16.4	27.4	14.2	2.7	3.9	15.6
Fe (mg/l)	<0.005	<0.005	<0.005	0.029	0.008	0.003	0.006	0.013	0.007	0.001	0.006	0.007	0.013	0.005	0.008	0.022
HCO_3 (mg/l)	95.4	17.2	64.0	129.0	116.8	18.7	84.0	152.0	30.6	2.8	26.0	38.0	26.3	3.0	19.0	34.0
K (mg/l)	1.4	0.3	1.1	2.0	1.5	0.3	0.9	2.3	1.5	0.2	1.1	1.8	2.5	0.5	0.6	3.3
Mg (mg/l)	12.0	2.5	2.9	13.8	12.2	1.1	8.8	13.6	5.0	0.4	3.6	5.5	2.8	0.5	1.0	3.1
Na (mg/l)	13.1	1.2	10.1	15.0	12.4	1.1	9.0	13.3	16.9	1.6	11.3	18.3	10.1	3.8	2.4	19.7
N Kjeldahl (mg N/l)	<0.2	<0.2	<0.2	0.9	0.4	0.2	0.3	0.9	0.5	0.2	0.3	1.0	0.5	0.3	0.2	0.9
NH_4 (mg N/l)	<0.03	<0.03	<0.03	0.11	0.06	0.02	0.03	0.10	0.05	0.02	0.03	0.11	0.04	0.01	0.03	0.04
NO_3 (mg N/l)	18.3	1.3	16.0	20.3	17.9	2.2	13.2	22.0	11.1	1.5	7.3	13.6	6.6	3.0	1.5	17.6
P total (mg P/l)	0.05	0.02	0.02	0.06	0.05	0.02	0.03	0.09	0.04	0.03	0.02	0.09	0.27	0.64	0.02	1.84
PO_4 (mg P/l)	0.029	0.015	0.012	0.083	0.009	0.003	0.006	0.014	0.009	0.004	0.006	0.018	0.010	0.005	0.006	0.023
SO_4 (mg/l)	118.9	5.6	110.0	133.0	75.1	3.5	68.0	81.1	40.0	1.4	36.8	42.0	14.6	2.0	6.7	15.8
Temp – spring (°C)	9.9	1.1	8.0	11.7	10.1	3.1	5.2	14.8	9.7	1.5	7.1	12.7	9.7	0.7	8.4	11.0
Temp – summer (°C)	12.3	0.6	11.2	14.8	15.5	1.0	13.1	17.6	12.6	0.8	11.2	14.8	11.6	0.4	10.7	12.4
Temp – autumn (°C)	11.0	0.9	9.2	12.6	10.9	2.1	7.4	15.0	9.8	1.6	7.5	12.8	10.7	0.7	9.4	12.0
Temp – winter (°C)	7.8	1.1	5.6	9.9	5.2	1.6	2.8	9.3	5.3	1.5	3.3	8.7	8.4	0.8	6.7	10.0

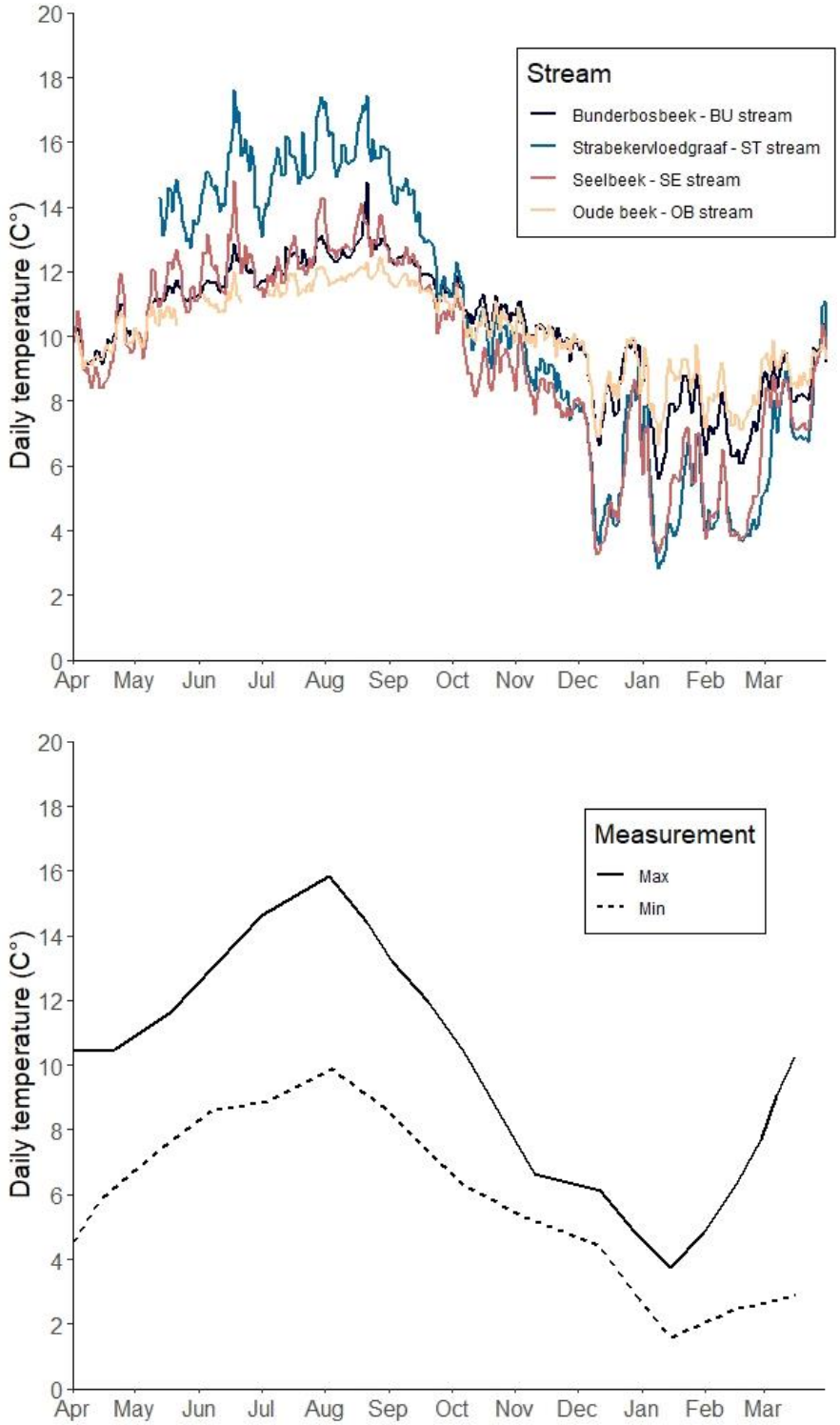

Figure S1: Daily water temperature for a) mean temperature for the four studied streams, based on measurements taken every 15 minutes from April 2002 until April 2003 with an OTD-diver (Van Essen instruments, Delft, The Netherlands) and b) minimum and maximum temperature in the un-impacted stream Breitenbach, based on measurements from July 1971 to June 1972 (Castro, 1975).

Substrate coverage

In each 5 m stream section, the areal coverage of each substrate category was mapped every two weeks during the first year using the grid method sectioned in 10 cm squares (Gordon et al.. 1992). The substrate categories included silt and fine detritus (8 - 4 φ); coarse detritus, leaves and branches (< 4 φ); sand (4 – -1 φ); fine gravel (-1 – -3 φ); coarse gravel (-3 – -6 φ); and gravel (fine or coarse) covered by one of the other categories (Wentworth. 1922). Cobbles (-6 – -8 φ) and boulders (< −8 φ) were not present in the studied stream sections. Areal substrate coverage maps were digitalized in ArcInfo, and per 10 cm squares the most prevailing substrate type was determined in ArcGrid (Figure S2).

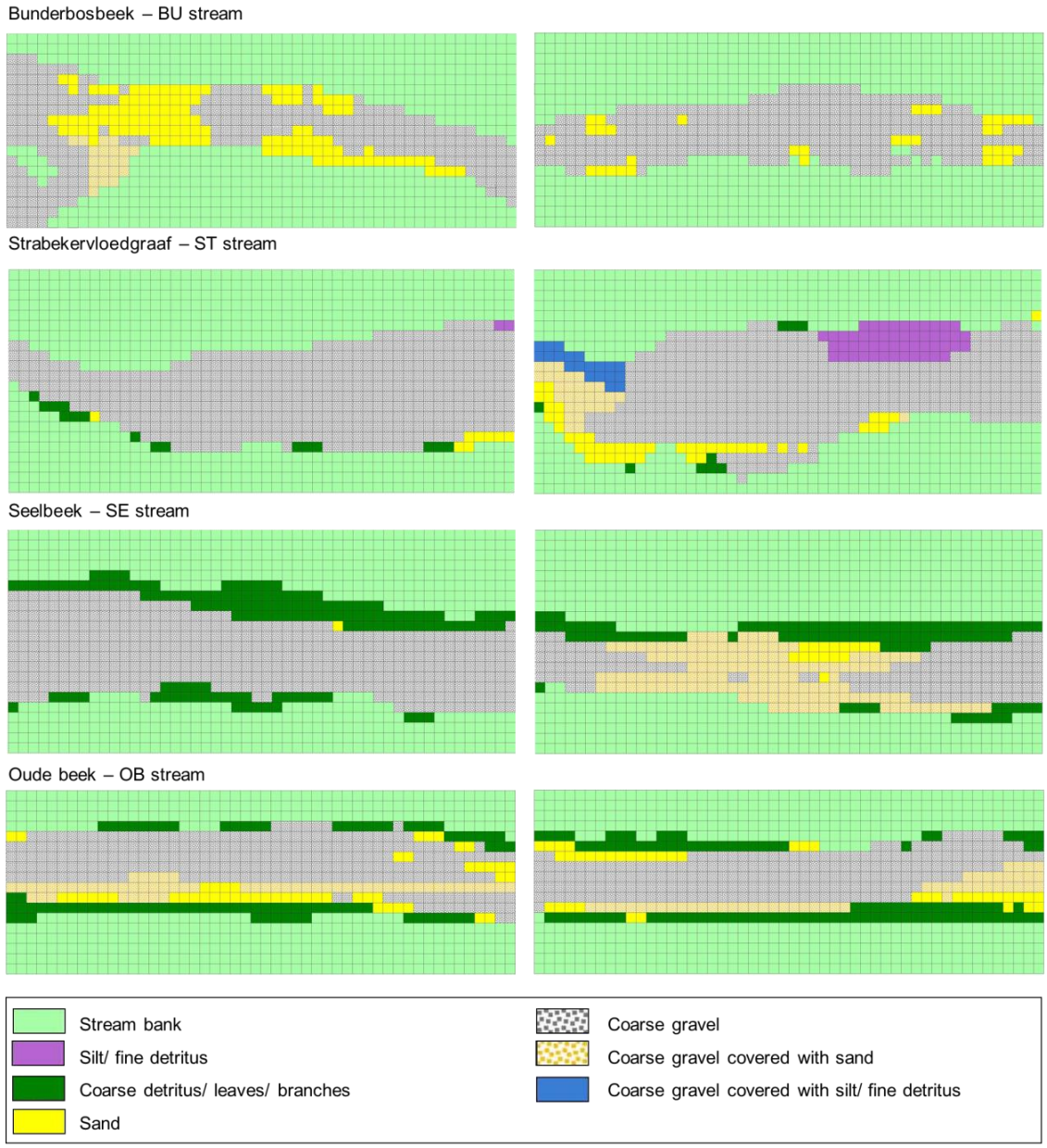

Figure S2: Most frequently observed substrate category in the two 5 meter sections per stream from April 2002 – April 2003. Each square on the map measures 10 by 10 cm in reality.

We categorized the substrate into suitable, i.e. fine and coarse gravel inhabited by A. fuscipes (gravel), and unsuitable, i.e. fine and coarse gravel covered by one of the other categories (covered gravel). Gravel bed coverage followed a seasonal pattern in the BU stream and SE stream, with a high percentage of gravel covered by sand, silt or detritus during autumn (Figure S3a), and autumn and spring respectively (Figure S3c). The gravel bed coverage changed in a flashy pattern in the ST stream (Figure S3b) and OB stream (Figure S3d).

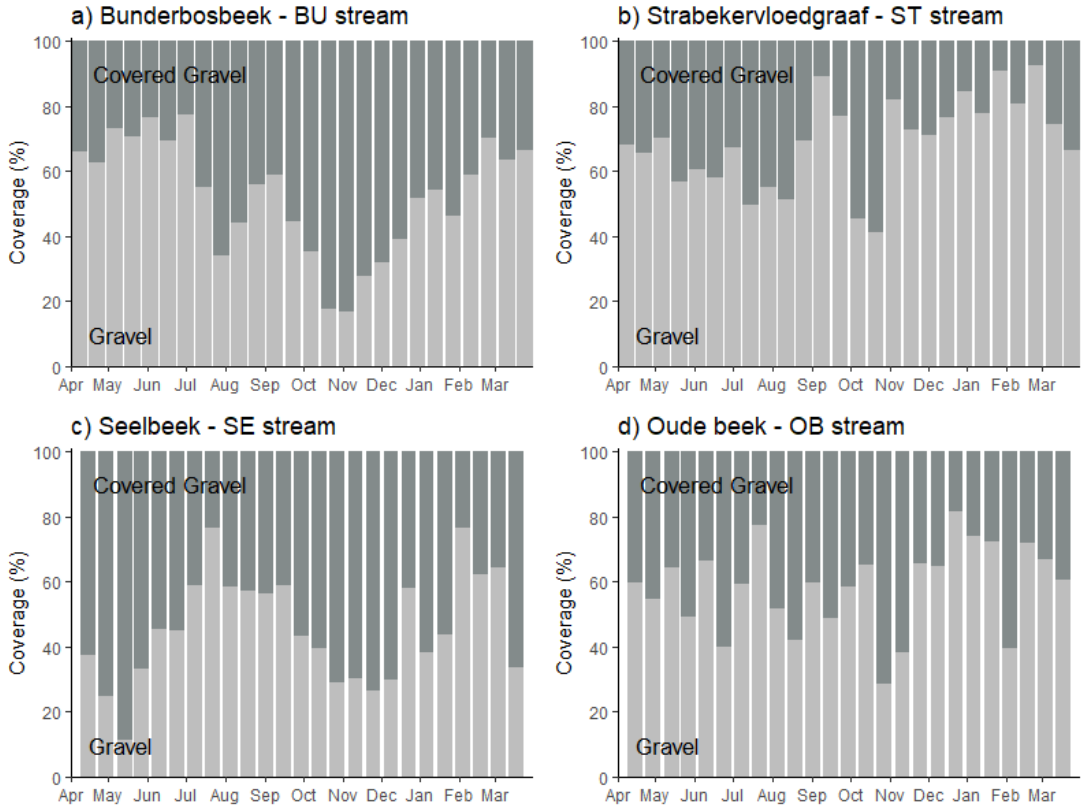

Figure S3: Gravel coverage from March 2002 until March 2003 in four streams a) Bunderbosbeek (BU stream), b) Strabekervloedgraaf (ST stream), c) Seelbeek (SE stream), d) Oude beek (OB stream).

References

Gordon, N. D., McMahon, T. A., Finlayson, B. L. (1992). *Stream hydrology: an introduction for ecologists*. Chichester: John Wiley and Sons.

Wentworth, C. K. (1922). A scale of grade and class terms for clastic sediments. *The journal of geology*, 30(5), 377-392.

Supplementary material B: Stage population model

Table S1: Death rates set for each model to ensure approximate population density loss given the model assumes exponential decay.

Spate intensity	Larvae instar	Model							
		Constant low		Constant high		Decrease		Increase	
		Density loss (%)	Death rate (day^{-1})	Density loss (%)	Death rate (day^{-1})	Density loss (%)	Death rate (day^{-1})	Density loss (%)	Death rate (day^{-1})
High	1	0.6	0.015	80.0	2.175	80.0	2.175	0.3	0.008
High	2	0.5	0.014	80.0	2.175	35.9	0.976	0.7	0.018
High	3	0.5	0.013	80.0	2.175	16.1	0.438	1.5	0.04
High	4	0.4	0.012	80.0	2.175	7.2	0.197	3.2	0.088
High	5	0.4	0.011	80.0	2.175	3.2	0.088	7.2	0.197
High	6	0.4	0.010	80.0	2.175	1.5	0.040	16.1	0.438
High	7	0.3	0.009	80.0	2.175	0.7	0.018	35.9	0.976
High	8	0.3	0.008	80.0	2.175	0.3	0.008	80.0	2.175
Medium	1	0.6	0.015	40.0	1.086	40.0	1.086	0.3	0.008
Medium	2	0.5	0.014	40.0	1.086	19.8	0.538	0.6	0.016
Medium	3	0.5	0.013	40.0	1.086	9.8	0.267	1.2	0.032
Medium	4	0.4	0.012	40.0	1.086	4.9	0.132	2.4	0.065
Medium	5	0.4	0.011	40.0	1.086	2.4	0.065	4.9	0.132
Medium	6	0.4	0.010	40.0	1.086	1.2	0.032	9.8	0.267
Medium	7	0.3	0.009	40.0	1.086	0.6	0.016	19.8	0.538
Medium	8	0.3	0.008	40.0	1.086	0.3	0.008	40.0	1.086
Small	1	0.6	0.015	20.0	0.545	20.0	0.545	0.3	0.008
Small	2	0.5	0.014	20.0	0.545	11.0	0.298	0.5	0.015
Small	3	0.5	0.013	20.0	0.545	6.0	0.163	1.0	0.027
Small	4	0.4	0.012	20.0	0.545	3.3	0.089	1.8	0.049
Small	5	0.4	0.011	20.0	0.545	1.8	0.049	3.3	0.089
Small	6	0.4	0.010	20.0	0.545	1.0	0.027	6.0	0.163
Small	7	0.3	0.009	20.0	0.545	0.5	0.015	11.0	0.298
Small	8	0.3	0.008	20.0	0.545	0.3	0.008	20.0	0.545

Supplementary material C: Flow duration curves

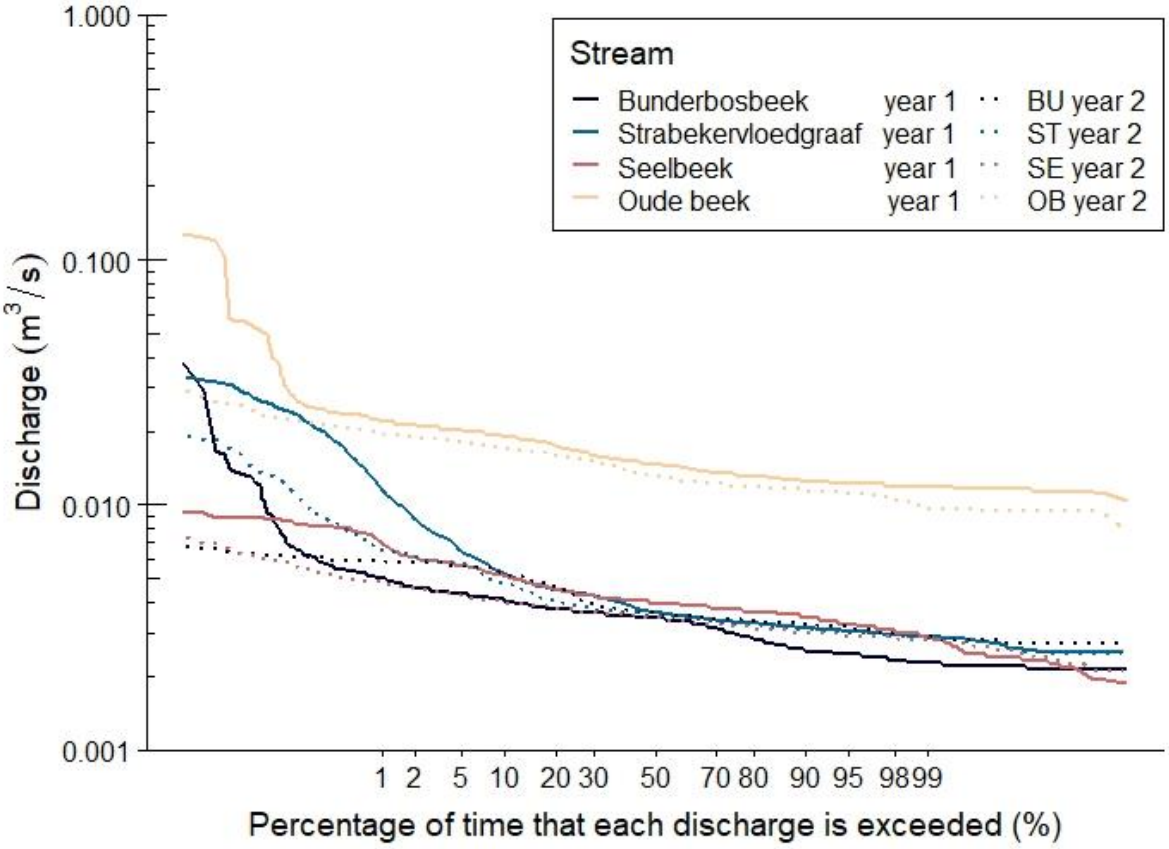

Figure S1: Flow duration curves for the four streams during year 1 (April 2002 – April 2003) and year 2 (April 2003 – April 2004). based on 15 minute data.