

Appendix 1. Niche parameters of 41 invertebrate species.

Species	SPP_CODE	Inertia	OMI	Tol	RTol	OMI%	Tol%	RTol%	p-value
<i>Heterocypris</i> sp.	Ost1	5.71	0.88	0.49	4.33	15.4	8.7	75.9	0.000
<i>Cytheromorpha</i> sp. 1	Ost2	5.68	0.76	0.39	4.53	13.3	6.9	79.8	0.000
<i>Candonia</i> sp.	Ost4	10.02	5.74	1.03	3.25	57.3	10.3	32.4	0.000
<i>Cypricerus</i> sp.	Ost5	9.78	4.71	1.44	3.64	48.1	14.7	37.2	0.000
<i>Cypridopsis</i> cf. <i>mariae</i>	Os5A	9.78	2.62	1.88	5.28	26.8	19.2	54	0.000
<i>Potamocypris</i> sp.	Ost6	7.65	1.25	0.96	5.43	16.4	12.6	71	0.000
<i>Genus species, indet.</i>	Ost7	6.18	1.63	0.19	4.36	26.4	3	70.6	0.103
<i>Genus species, indet.</i>	Ost8	8.82	2.50	1.65	4.67	28.3	18.7	53	0.139
<i>Cytheromorpha</i> sp. 2	Ost9	8.58	3.65	1.69	3.24	42.5	19.7	37.8	0.001
<i>Genus species, indet.</i>	Os10	7.10	2.08	1.42	3.61	29.2	19.9	50.8	0.043
<i>Cyprideis</i> sp.	Os13	7.77	2.55	0.92	4.30	32.8	11.9	55.3	0.000
<i>Genus species, indet.</i>	Os14	10.17	3.27	2.74	4.16	32.1	26.9	40.9	0.008
<i>Nitocra spinipes</i>	Harp	7.57	0.73	1.23	5.61	9.6	16.3	74.1	0.000
<i>Genus species, indet.</i>	HarpM	8.46	2.22	0.64	5.59	26.3	7.6	66.1	0.000
<i>Orthocyclops modestus</i>	CycL	7.45	0.11	0.96	6.37	1.5	12.9	85.6	0.000
<i>Genus species, indet.</i>	Cyc9	5.96	0.84	0.81	4.31	14.1	13.6	72.4	0.035
<i>Paracyclops fimbriatus</i>	CycS	6.46	0.31	0.72	5.43	4.7	11.2	84.1	0.004
<i>Metis</i> sp.	CycM	7.44	2.04	0.34	5.06	27.4	4.6	68	0.000
<i>Ceriodaphnia rigaudi</i>	Daphn	9.95	4.48	1.54	3.94	45	15.4	39.6	0.000
<i>Leidigia leidigi</i>	Leid	9.15	6.01	0.60	2.54	65.7	6.6	27.8	0.000
<i>Alona davidii</i>	Alon	7.60	1.64	0.65	5.30	21.6	8.6	69.8	0.000
<i>Sesarma miersi</i>	CrabL	6.81	0.16	0.78	5.86	2.3	11.5	86.1	0.008
<i>Genus species, indet.</i>	MidgL	10.83	2.66	0.80	7.37	24.5	7.4	68.1	0.000
<i>Genus species, indet.</i>	Tany	9.32	1.31	1.12	6.89	14	12	74	0.000
<i>Genus species, indet.</i>	TanyT	9.79	3.14	1.89	4.76	32.1	19.3	48.7	0.000
<i>Culex</i> sp.	Mos1	6.34	0.29	0.60	5.45	4.6	9.5	85.9	0.001
<i>Genus species, indet.</i>	Mos2	10.08	2.39	1.74	5.95	23.7	17.3	59	0.014
<i>Genus species, indet.</i>	MosLR	5.91	1.97	0.54	3.40	33.3	9.2	57.5	0.313
<i>Genus species, indet.</i>	Bet1	10.43	5.54	1.30	3.59	53.1	12.5	34.4	0.000
<i>Genus species, indet.</i>	Dipter	8.35	3.31	0.51	4.53	39.7	6.1	54.2	0.000
<i>Genus species, indet.</i>	Nema	6.75	0.20	1.16	5.40	2.9	17.1	79.9	0.015
<i>Gyratrix hermaphroditus</i>	Gyratr	6.59	0.71	0.93	4.95	10.7	14.1	75.2	0.000
<i>Macrostomum</i> sp.	Macr	5.61	3.65	0.28	1.69	65	4.9	30.1	0.112
<i>Gieysztoria rastafariae</i>	Daly2	7.36	2.99	0.37	3.99	40.6	5.1	54.3	0.041
<i>Genus species, indet.</i>	Oligo	7.45	0.98	0.91	5.56	13.2	12.2	74.6	0.000
<i>Genus species, indet.</i>	PolyT	6.51	1.44	0.45	4.61	22.2	6.9	70.9	0.002
<i>Genus species, indet.</i>	PolyJ	5.97	1.86	0.37	3.74	31.2	6.3	62.5	0.001
<i>Genus species, indet.</i>	Poly4	8.38	3.17	0.16	5.05	37.8	1.9	60.3	0.104
<i>Genus species, indet.</i>	PolyF	8.94	6.85	0.46	1.64	76.6	5.1	18.3	0.015
<i>Genus species, indet.</i>	ShrimM	6.98	1.99	0.60	4.38	28.6	8.7	62.7	0.048
<i>Genus species, indet.</i>	Isopod	9.03	4.11	0.31	4.62	45.4	3.4	51.1	0.037

Inertia = variability of species niche; OMI= outlying mean index or niche position, marginality; Tol species tolerance or species niche breadth, RTol residual tolerance, i.e. variability in the species niche that is not explained by the set of environmental variables that define marginality axis; Percentages% = percentage of the total niche variability, i.e. inertia, explained by each niche index; p-values = significance that species' OMI value is different from that expected by chance (10 00 permutations)

**Appendix 2.** Correlation between nested ranks of species as maximally packed by BINMATNEST across years and niche parameters. OMI = outlying mean index or niche position; Tol = species tolerance or niche breadth, RTol = residual tolerance index. Values are Spearman's rank correlation coefficient (Fig. 3). NTC\_RTol is correlation between nested rank according NTC (Figure 3).

Niche index	1989/90	1991	1992	Species nested ranks in:				
				1993	1997	1998	2001	2002
OMI	0.535***	0.483*	0.690***	0.746***	0.696***	0.562***	0.515**	0.564***
Tol	-0.123	-0.117	-0.168	0.050	-0.230	-0.054	-0.405*	-0.106
RTol	-0.506**	-0.500*	-0.591***	-0.664***	-0.558***	-0.463**	-0.466**	-0.332 <sup>a</sup>
NTC_RTol	-0.503**	-0.445*	-0.469**	-0.575***	-0.522**	-0.415**	-0.460**	-0.366*

<sup>a</sup> p < 0.10, \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

**Appendix 3.** Correlation between the nested ranks of species and pools in the benchmark data (Year-1989/90) as maximally packed by BINMATNEST and NTC and the proportions of extinction and colonization computed for species and pools, respectively, in successive years in relation to the benchmark.  $E_{\text{spp}}$  and  $C_{\text{spp}}$  are the number of pools on which a given species went locally extinct and colonized, respectively.  $E_{\text{pool}}$  and  $C_{\text{pool}}$  are the proportion of species that went locally extinct and colonized a pool, respectively. Values are Spearman's rank correlation. The relationship between nested rank of species as packed by NTC and species-based turnover dynamics is shown in Fig. 4.

METHOD						
	1991	1992	1993	1997	1998	2001
BINMATNEST						
(a) Species-based						
Extinction ( $E_{\text{spp}}$ )	<b>0.68***</b>	0.234	<b>0.587***</b>	<b>0.634***</b>	0.308 <sup>a</sup>	<b>0.566***</b>
Colonization ( $C_{\text{spp}}$ )	<b>-0.752***</b>	<b>-0.423*</b>	<b>-0.689***</b>	<b>-0.561***</b>	<b>-0.375*</b>	<b>-0.572***</b>
(b) Pool-based						
Extinction ( $E_{\text{pool}}$ )	-0.222	0.036	-0.268	-0.13	-0.075	-0.318*
Colonization ( $C_{\text{pool}}$ )	0.066	-0.1	0.072	-0.055	-0.239	0.06
NTC						
(b) Pool-based						
Extinction ( $E_{\text{pool}}$ )	-0.166	-0.038	-0.185	-0.195	-0.094	-0.245
Colonization ( $C_{\text{pool}}$ )	0.066	-0.072	-0.121	-0.046	-0.075	0.080

<sup>a</sup>  $p < 0.10$ , \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

**Appendix 4.** Correlation between proportions of extinction and colonization computed for species and pools, respectively, in successive years (Turnover year) nested ranks of species and pools as maximally packed by NTC in relation to preceding year (Nested year). Results by BINMATNEST were very similar.  $E_{Spp}$  and  $C_{Spp}$  are the proportion of pools on which a given species went locally extinct and colonized, respectively.  $E_{Pool}$  and  $C_{Pool}$  are the proportion of species that went locally extinct and colonized a pool, respectively. Values are Spearman's rank correlation (Fig. 4. and Appendix 3).

Nested year vs Turnover year	Nestedness analysis	
	Extinctions ( $E_{Spp}$ )	Colonizations ( $C_{Spp}$ )
Nested year vs Turnover year		
Species-based		
1989/90 vs 1991	<b>0.709***</b>	<b>-0.734***</b>
1991 vs 1992	<b>0.411<sup>a</sup></b>	<b>-0.489*</b>
1992 vs 1993	<b>0.398*</b>	<b>-0.721***</b>
1993 vs 1997	<b>0.401*</b>	<b>-0.778***</b>
1997 vs 1998	-0.031	<b>-0.489**</b>
1998 vs 2001	<b>0.507**</b>	<b>-0.644**</b>
2001 vs 2002	<b>0.408**</b>	<b>-0.717***</b>
Pool-based	Extinction ( $E_{Pool}$ )	Colonization ( $C_{Pool}$ )
1989/90 vs 1991	0.126	-0.167
1991 vs 1992	-0.044	0.133
1992 vs 1993	0.004	-0.209
1993 vs 1997	-0.237	-0.174
1997 vs 1998	-0.187	-0.190
1998 vs 2001	0.180	-0.143
2001 vs 2002	-0.267	0.260

<sup>a</sup> p < 0.10, \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

**Appendix 5.** Correlation between species residual tolerance index (RTol), i.e. variability in the species distribution that is not explained by the set of environmental variables that define niche-axis and the proportion of pools on which a given species went locally extinct ( $E_{Spp}$ ) or colonized ( $C_{Spp}$ ) in successive years in relation to the benchmark year.

	1991	1992	1993	1997	1998	2001	2002
Extinction ( $E_{Spp}$ )	-0.165	0.123	-0.004	-0.215	0.022	-0.08	0.033
Colonization ( $C_{Spp}$ )	<b>0.455**</b>	<b>0.419*</b>	<b>0.578***</b>	<b>0.493**</b>	<b>0.412*</b>	<b>0.533**</b>	<b>0.429*</b>

\*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

**Appendix 6.** Summary of the relationships between temporal dynamics (broken-line oval), nestedness (solid thick-line oval) and niche metrics (solid thin-line oval) as defined by environmental variables (solid thin-line rectangle). See Methods for calculation of (A) species- and (B) pool-specific extinction and colonization rates (broken line oval). The lines show the relationship between compartments; solid thick-line = significant and consistent relationship; solid thin-line = weak or inconsistent relationship; broken-line = no relationship; no line – relationship not examined or not feasible. <sup>§</sup> Species that rank high in the nested matrix and species whose niche position (OMI) is closer to average habitat condition have smaller values; hence the sign of relation becomes positive with extinction and negative with colonization.

