Marine and Freshwater Research, 2019, **70**, 563–575
https://doi.org/10.1071/MF18177

Supplementary material

Invertebrate responses to land use in tropical streams: discrimination of impacts enhanced by analysis of discrete areas

Richard G. Pearson[A,B,E], *Niall Connolly*[A,B], *Lee J. Benson*[A,C], *Andi Cairns*[A], *Paul Clayton*[A], *Michael Crossland*[A], *Kent G. Hortle*[A,D], *Katie Leonard*[A] *and Jacqui Nolen*[A]

[A]College of Science and Engineering, James Cook University, Townsville, Qld 4811, Australia.

[B]TropWater, James Cook University, Townsville, Qld 4811, Australia.

[C]Ecology Management Pty Ltd, 12/27 High Street, Lutwyche, Qld 4030, Australia.

[D]Institute of Land, Water and Society, Charles Sturt University, PO Box 789, Albury, NSW 2640, Australia.

[E]Corresponding author. Email: richard.pearson@jcu.edu.au

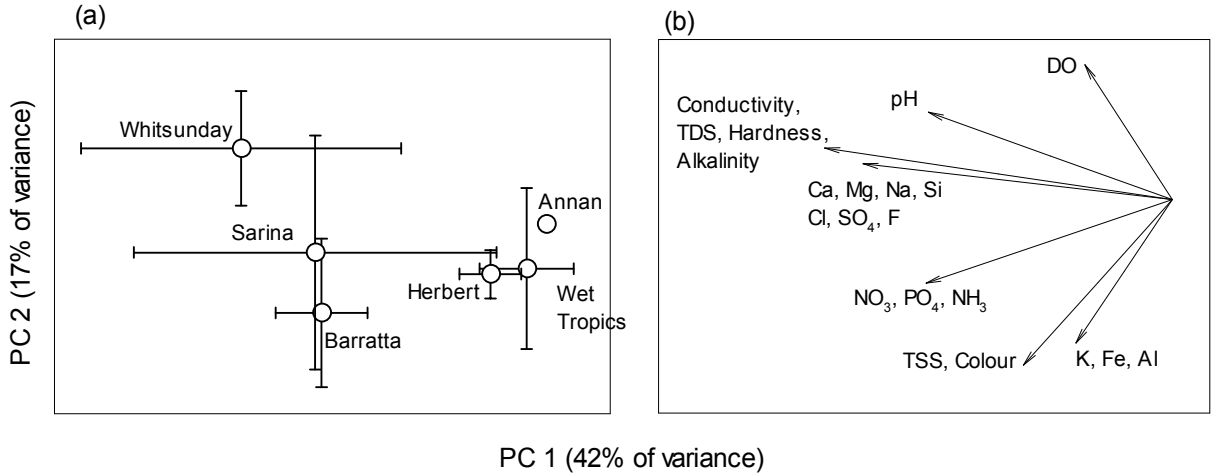

Fig. S1. Principal-component analysis (PCA) of data from ~2000 Queensland Government water-quality samples from 35 sites. (*a*) Centroids ± s.d. for each of six areas (relevant data for Atherton and Babinda were not available); (*b*) vectors showing variables having significant ($P < 0.05$) correlations with the first two axes. Variables were grouped according to similarity of their eigenvector values, and mean values were used to create vectors. Non-significant variables were discharge, turbidity, temperature, boron (B), copper (Cu), manganese (Mn) and zinc (Zn). PCA1 correlated with latitude ($r = 0.829$, $P = 0.006$); PCA2 correlated with total rainfall ($r = –0.703$, $P = 0.035$) and rainfall variation ($r = 0.914$, $P < 0.001$).

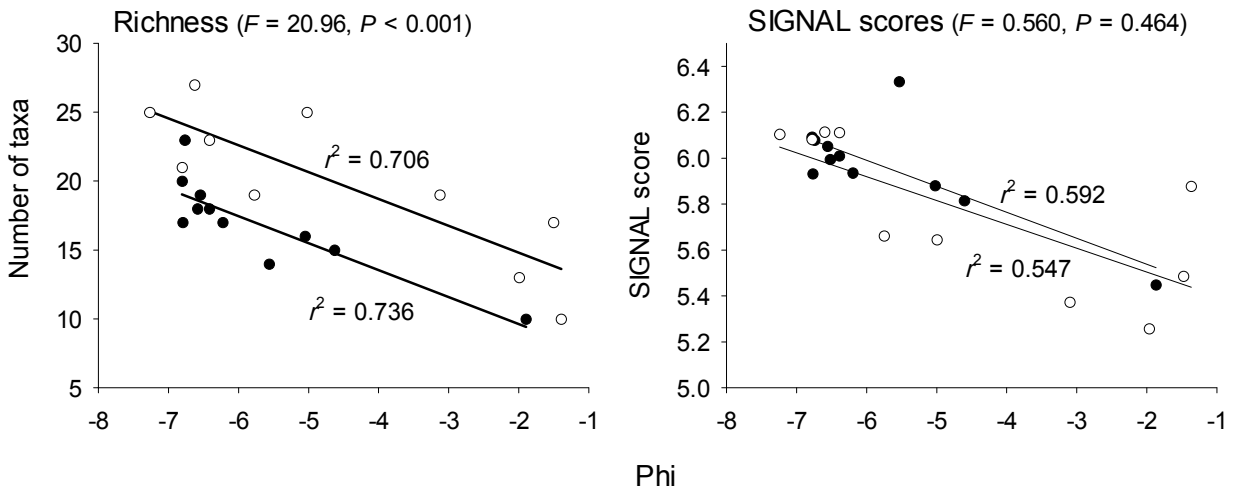

Fig. S2. Comparison of richness and SIGNAL scores, plotted against mean sediment size (Phi) between Babinda (closed circles) and Behana (open circles) creeks. Linear regression lines, associated r^2 values and results of ANCOVA comparing streams are shown. d.f. = 19.

Table S1. Locations and characteristics of study streams and associated land use, sorted by latitude and longitude within areas

Dunder is waste from Sarina distillery, applied to land as a fertiliser

Study area, date	Stream	Latitude (°S)	Longitude (°E)	Altitude (m)	Gradient (%)	Catchment area (km^2)	Percentage forest	Percentage grazing	Percentage cropping	Percentage urban	Other influence
Annan, May–November 1998											
	Annan	15.632	145.194	49	2.6	276.0	96.8	3.2	0.0	0.0	
	Annan	15.703	145.225	130	4.0	215.0	96.8	3.2	0.0	0.0	Mining
	Mungumby	15.706	145.254	133	8.8	15.9	99.4	0.6	0.0	0.0	
	Wallaby	15.743	145.261	177	5.5	63.0	99.4	0.6	0.0	0.2	Mining
	Wallaby	15.748	145.281	195	4.1	30.0	99.1	0.7	0.2	0.0	
	Annan	15.749	145.225	149	5.3	124.0	99.5	0.0	0.0	0.0	Mining
	Rossville	15.752	145.270	194	11.8	6.3	34.9	62.7	0.0	2.4	Mining
	Jones	15.752	145.274	187	14.2	3.3	100.0	0.0	0.0	0.0	Mining
	Adams	15.755	145.299	156	10.1	1.6	100.0	0.0	0.0	0.0	
	Creek A	15.779	145.218	160	13.6	1.8	100.0	0.0	0.0	0.0	
	Parrot	15.814	145.233	203	5.8	18.0	97.2	2.8	0.0	0.0	Mining
	Annan	15.815	145.232	202	8.0	40.9	100.0	0.0	0.0	0.0	
	Annan	15.815	145.233	210	8.5	21.9	100.0	0.0	0.0	0.0	
	Gap	15.815	145.330	112	15.6	4.4	100.0	0.0	0.0	0.0	
	Romeo	15.823	145.231	235	6.4	25.0	100.0	0.0	0.0	0.0	Mining
	Tea Tree	15.826	145.226	214	11.3	11.9	100.0	0.0	0.0	0.0	
Wet Tropics, May 1993–December 1995											
	Scrubby	15.685	145.282	130	31.3	0.6	100.0	0.0	0.0	0.0	
	O'Keefe	15.706	145.255	199	20.9	2.9	100.0	0.0	0.0	0.0	
	Lorna Doone	15.748	145.281	195	8.1	30.0	99.1	0.7	0.2	0.0	
	Annan	15.815	145.233	210	8.5	21.9	100.0	0.0	0.0	0.0	
	Gap	15.815	145.330	112	15.6	4.4	100.0	0.0	0.0	0.0	
	Woobooda	15.954	145.345	30	5.5	11.8	99.2	0.8	0.0	0.0	
	Baird	16.028	145.281	190	3.1	30.3	87.8	12.2	0.0	0.0	
	Hartley	16.656	145.563	12	7.4	11.6	100.0	0.0	0.0	0.0	
	Shoteel	16.923	145.588	389	0.7	12.0	92.5	7.5	0.0	0.0	
	Clohesy	16.975	145.592	460	6.3	12.1	100.0	0.0	0.0	0.0	
	Malbon	17.158	145.900	19	28.4	1.9	100.0	0.0	0.0	0.0	
	Harvey	17.251	145.905	60	24.3	8.1	100.0	0.0	0.0	0.0	
	Mulgrave	17.257	145.775	86	7.7	79.0	100.0	0.0	0.0	0.0	
	N. Johnstone	17.416	145.657	603	16.6	2.1	100.0	0	0.0	0.0	

Study area, date	Stream	Latitude (°S)	Longitude (°E)	Altitude (m)	Gradient (%)	Catchment area (km^2)	Percentage forest	Percentage grazing	Percentage cropping	Percentage urban	Other influence
	Charappa	17.683	145.683	620	1.8	27.5	100.0	0	0.0	0.0	
	Tully	17.779	145.670	80	1.8	374.0	99.9	0.1	0.0	0.0	
	Pixies	17.789	145.679	77	13.7	5.2	100.0	0.0	0.0	0.0	
	Murray	18.153	145.822	150	6.3	13.3	100.0	0.0	0.0	0.0	
	Five Mile	18.337	146.033	68	9.0	15.3	100.0	0.0	0.0	0.0	
	Broadwater	18.417	145.943	55	3.9	70.6	100.0	0.0	0.0	0.0	
Babinda, July 2005											
	Behana	17.118	145.848	12	5.5	103.4	82.1	0.0	17.6	0.3	
	Behana	17.118	145.860	12	5.2	106.2	79.9	0.0	19.9	0.3	
	Behana	17.127	145.834	12	5.9	94.8	87.6	0.0	12.1	0.2	
	Behana	17.129	145.833	15	6.1	85.5	93.6	0.0	6.3	0.1	
	Behana	17.139	145.828	21	6.2	70.5	95.7	0.0	4.3	0.0	
	Behana	17.151	145.829	24	6.5	69.0	97.1	0.0	2.9	0.0	
	Behana	17.158	145.830	35	6.8	66.8	100.0	0.0	0.0	0.0	
	Behana	17.176	145.836	74	7.0	63.1	99.8	0.0	0.0	0.0	
	Behana	17.185	145.825	143	7.2	46.5	100.0	0.0	0.0	0.0	
	Babinda	17.343	145.870	63	10.2	14.9	97.9	1.3	0.7	0.0	
	Babinda	17.346	145.870	40	10.4	39.3	99.0	0.5	0.5	0.0	
	Babinda	17.351	145.925	10	14.2	17.0	100.0	0.0	0.0	0.0	
	Babinda	17.352	145.876	62	10.0	37.3	99.2	0.5	0.3	0.0	
	Babinda	17.353	145.878	30	8.7	50.5	97.0	0.9	2.0	0.0	
	Babinda	17.357	145.885	25	8.0	60.1	94.7	0.9	4.1	0.0	
	Babinda	17.357	145.893	19	7.4	62.7	92.0	0.8	6.8	0.3	
	Babinda	17.362	145.923	12	4.9	83.9	80.7	1.1	14.9	1.7	
	Babinda	17.363	145.906	17	6.7	70.8	86.4	1.4	10.4	0.3	
	Babinda	17.367	145.910	15	5.2	80.5	82.7	1.2	14.3	0.5	
Atherton, September–November 1998											
	Spring	17.170	145.487	637	1.6	16.1	1.9	0.0	98.1	0.0	
	Barney Springs	17.177	145.459	650	6.7	0.1	100.0	0.0	0.0	0.0	
	Cherry	17.180	145.527	630	2.4	7.6	0.0	17.1	82.9	0.0	
	Rocky	17.182	145.449	655	3.1	29.9	52.5	24.4	13.4	9.7	
	Mazlin	17.223	145.537	688	1.7	62.9	22.3	0.0	67.6	10.2	
	Mazlin	17.236	145.504	726	2.4	53.0	26.4	0.0	61.7	11.9	
	Mazlin	17.255	145.477	748	3.5	28.1	49.8	0.0	33.1	17.1	
	Mazlin	17.260	145.463	770	4.4	9.1	46.2	16.5	37.4	0.0	
	Barron	17.264	145.538	695	1.2	127.0	29.5	36.6	33.9	0.0	
	Peterson	17.285	145.577	693	0.7	10.0	9.0	45.0	46.0	0.0	

Study area, date	Stream	Latitude (°S)	Longitude (°E)	Altitude (m)	Gradient (%)	Catchment area (km^2)	Percentage forest	Percentage grazing	Percentage cropping	Percentage urban	Other influence
	Imrie	17.294	145.635	752	4.4	5.6	21.4	75.0	0.0	3.6	
	Leslie	17.301	145.563	699	1.2	41.0	2.4	48.8	48.8	0.0	
	Barron	17.310	145.522	709	1.6	97.7	38.4	36.0	25.6	0.0	
	Nicholas	17.338	145.511	743	2.8	7.5	0.0	82.7	17.3	0.0	
	Goonarra	17.339	145.501	756	2.3	50.5	50.5	49.5	0.0	0.0	
	N. Johnstone	17.344	145.635	712	1.6	56.0	6.1	46.4	38.4	9.1	
	Ahyah	17.345	145.515	741	2.1	6.5	0.0	0.0	100.0	0.0	
	Gwynne	17.345	145.538	744	2.0	6.8	4.4	41.2	54.4	0.0	
	N. Johnstone	17.359	145.589	748	2.2	19.2	3.6	80.7	15.6	0.0	
	N. Johnstone	17.363	145.642	690	1.5	60.8	8.1	45.2	38.7	8.1	
	N. Johnstone trib.	17.364	145.655	711	4.5	2.1	4.8	95.2	0.0	0.0	
	N. Johnstone trib.	17.371	145.576	742	7.2	0.8	0.0	100.0	0.0	0.0	
	N. Johnstone trib.	17.371	145.652	695	4.1	2.7	3.7	96.3	0.0	0.0	
	Ithaca	17.373	145.634	711	0.9	45.3	16.6	75.1	8.4	0.0	
	Bromfield	17.377	145.553	754	2.2	2.1	28.6	71.4	0.0	0.0	
	Short	17.383	145.665	740	3.2	6.0	3.3	56.7	40.0	0.0	
	Gwynne	17.388	145.533	804	3.7	2.6	19.2	80.8	0.0	0.0	
	Barron	17.432	145.488	940	6.2	0.8	100.0	0.0	0.0	0.0	
	Beatrice	17.560	145.603	759	2.8	6.2	82.3	17.7	0.0	0.0	
Herbert, December 1998–September 1999											
	Arnot	18.541	146.178	20	10.9	4.6	67.4	0.0	30.4	2.2	
	Lagoon	18.577	146.260	6	0.1	1.7	0.0	0.0	100.0	0.0	
	Ripple	18.588	146.146	22	3.2	33.2	89.5	4.8	5.7	0.0	
	Ripple	18.588	146.182	12	2.3	40.5	76.3	4.0	19.8	0.0	
	Hawkins	18.590	146.064	20	19.0	2.5	60.0	20.0	20.0	0.0	
	Ripple	18.590	146.166	13	2.6	38.2	78.8	4.2	17.0	0.0	
	Red Roof	18.593	146.116	23	15.1	1.7	88.2	5.9	5.9	0.0	
	Drain	18.594	146.159	17	0.6	10.2	16.7	2.0	81.4	0.0	
	Drain	18.602	146.140	15	1.0	7.0	10.0	2.9	87.1	0.0	
	Lannercost	18.619	146.024	21	1.9	67.2	85.6	0.0	14.4	0.0	
	Macausland	18.688	146.107	18	0.1	16.6	27.1	0.0	72.9	0.0	
	Palm	18.696	146.228	7	0.0	50.9	1.2	3.1	83.1	12.6	
	Cattle	18.703	146.118	16	5.2	2.3	43.5	0.0	56.5	0.0	
	Trebonne	18.719	146.184	14	0.1	114.6	32.7	2.2	63.7	1.4	
	Cattle	18.774	146.195	10	2.7	7.6	0.7	0.0	99.3	0.0	
	Waterview	18.842	146.190	15	4.1	50.5	80.6	0.0	19.4	0.0	

Study area, date	Stream	Latitude (°S)	Longitude (°E)	Altitude (m)	Gradient (%)	Catchment area (km^2)	Percentage forest	Percentage grazing	Percentage cropping	Percentage urban	Other influence
Barratta, August 1991–March 1992											
	E. Barratta	19.556	147.159	10	2.0	36.5	23.3	23.3	53.4	0.0	
	Barratta	19.619	147.139	15	0.4	157.0	21.7	78.3	0.0	0.0	
	Barratta	19.619	147.139	18	1.1	41.4	16.2	16.2	67.6	0.0	
	Barratta	19.619	147.139	16	0.4	498.0	42.6	42.8	14.7	0.0	
	Drain	19.660	147.214	17	0.5	3.5	0.0	74.3	25.7	0.0	
	Barratta	19.707	147.147	22	0.5	395.0	44.3	44.3	11.4	0.0	
	Barratta	19.735	147.084	33	1.0	61.0	50.0	50.0	0.0	0.0	
	Pelican	19.787	147.154	27	0.1	9.6	34.4	0.0	65.6	0.0	
	Clay	19.809	147.093	33	0.5	157.0	21.7	78.3	0.0	0.0	
Whitsunday, September–November 1992-1993											
	Andromache	20.571	148.477	42	1.3	253.0	26.9	73.1	0.0	0.0	
	O'Connell	20.675	148.578	31	1.3	202.0	44.8	49.5	5.7	0.0	
	O'Connell	20.762	148.597	46	1.5	171.0	48.5	47.7	3.7	0.0	
	St Helens	20.925	148.731	34	3.9	83.0	81.6	18.4	0.0	0.0	
	St Helens	20.945	148.718	44	4.5	67.0	87.2	12.8	0.0	0.0	
	St Helens	20.963	148.697	63	5.5	42.0	89.0	11.0	0.0	0.0	
	Finch Hatton	21.084	148.638	141	11.8	25.3	100.0	0.0	0.0	0.0	
	Finch Hatton	21.128	148.637	98	6.9	41.0	84.9	13.7	1.5	0.0	
	Pioneer	21.138	148.631	96	2.6	121.0	66.1	13.2	20.7	0.0	
	Pioneer	21.141	148.934	40	0.8	1223.0	67.3	4.9	27.6	0.2	
	Bakers	21.174	149.085	21	0.1	29.4	0.0	19.0	72.8	8.2	
	Blacks	21.226	148.817	49	0.8	520.0	92.1	3.8	4.0	0.0	
	Blacks	21.309	148.835	60	1.0	390.0	96.9	2.3	0.8	0.0	
Sarina, November 1990-1992											
	Sandy	21.230	148.950	37	5.0	24.4	0.0	13.9	86.1	0.0	
	Ross	21.256	149.005	31	1.0	3.5	37.1	34.3	28.6	0.0	Dunder
	Sandy	21.260	148.935	43	4.2	54.0	49.1	24.3	26.7	0.0	Dunder
	Sandy	21.277	149.050	24	1.8	254.0	22.0	32.1	45.7	0.2	
	Sandy	21.281	149.082	13	1.5	300.0	19.3	30.7	50.0	0.0	Dunder
	Oaky	21.296	149.011	28	3.5	14.6	58.2	11.0	30.8	0.0	Dunder
	Rock	21.302	149.048	23	1.9	18.0	25.0	33.3	41.7	0.0	Dunder
	Cabbage Tree	21.369	149.273	13	3.1	9.9	1.0	88.9	10.1	0.0	Dunder
	Plane	21.441	149.202	27	2.5	75.6	36.6	59.0	4.4	0.0	
	Plane	21.449	149.165	44	4.4	51.0	38.2	60.0	1.8	0.0	
	Plane	21.452	149.186	32	3.0	68.1	36.3	60.8	2.9	0.0	
	Tara	21.457	149.145	56	5.9	9.8	53.1	46.9	0.0	0.0	Dunder

Study area, date	Stream	Latitude (°S)	Longitude (°E)	Altitude (m)	Gradient (%)	Catchment area (km^2)	Percentage forest	Percentage grazing	Percentage cropping	Percentage urban	Other influence
	Cattle	21.463	149.152	55	6.6	14.1	70.2	29.8	0.0	0.0	
	Plane	21.464	149.151	56	6.3	31.3	36.1	63.9	0.0	0.0	Dunder
	Rocky Dam	21.600	149.400	24	0.9	113.0	54.4	16.7	28.8	0.0	
	Rocky Dam	21.670	149.302	36	1.5	41.1	35.3	45.3	19.5	0.0	Dunder
	Marion	21.703	149.395	21	1.4	64.2	57.8	25.1	17.1	0.0	
	Cone	21.704	149.270	58	2.5	7.8	35.9	51.3	12.8	0.0	Dunder
	Marion	21.705	149.398	21	1.4	74.5	59.2	26.0	14.8	0.0	
	Marion	21.734	149.292	74	2.8	29.5	61.0	39.0	0.0	0.0	
	Carmila	21.906	149.407	19	2.0	74.4	69.8	8.7	21.5	0.0	
	Carmila	21.910	149.326	59	4.3	17.8	84.3	14.0	1.7	0.0	

Table S2. Ubiquity of taxa: number of sampling areas (*n*) in which each taxon was recorded and proportion (%) of samples including each taxon in each sampling area and overall (All)

Parameter	*n* (areas)	All	Annan	WTWHA	Babinda	Atherton	Herbert	Barratta	Whitsunday	Sarina
Number of samples		203	22	38	19	29	26	9	24	36
Chironomidae	8	100	100	100	95	100	100	100	100	100
Baetidae	8	93	95	87	100	90	92	100	100	92
Leptophlebiidae	8	84	95	89	84	69	65	56	96	94
Caenidae	8	79	73	74	84	66	88	100	75	86
Hydropsychidae	8	78	95	100	84	79	46	78	83	61
Elmidae	7	74	82	100	100	76	0	78	88	72
Simuliidae	8	72	77	92	68	69	65	67	79	53
Leptoceridae	7	68	0	58	68	83	73	100	79	92
Philopotamidae	7	60	91	87	84	55	38	0	63	33
Psephenidae	6	56	41	89	95	52	0	0	83	50
Tipulidae	7	55	73	76	74	34	0	44	54	72
Ceratopogonidae	8	52	36	71	26	28	69	100	21	69
Oligochaeta	8	50	41	16	11	90	81	67	42	58
Pyralidae	6	49	0	66	79	45	0	78	83	53
Hydroptilidae	6	48	0	74	32	69	0	100	54	58
Hydracarina	7	46	0	92	42	66	92	33	4	11
Gomphidae	7	46	86	53	47	10	0	78	58	58
Gripopterygidae	6	42	77	87	79	14	0	0	33	22
Ecnomidae	6	31	0	24	11	48	0	67	29	69
Diphlebiidae	4	29	86	61	42	28	0	0	0	0
Atyidae	6	28	0	18	16	31	0	89	21	67
Copepoda	4	27	0	24	0	72	81	0	0	11
Ptilodactylidae	4	26	68	53	58	24	0	0	0	0
Megaloptera	4	24	55	47	37	38	0	0	0	0
Hydrophilidae	6	23	0	29	26	7	0	78	21	47
Ostracoda	6	23	0	3	5	86	46	0	13	14
Planorbidae	5	22	0	0	0	17	42	100	21	42
Calamoceratidae	6	21	0	39	11	38	0	22	4	31
Palaemonidae	6	20	0	13	26	14	0	44	46	31
Cladocera	4	19	0	0	0	62	65	0	4	8
Empididae	5	19	0	39	47	41	0	22	0	3
Turbellaria	6	19	36	13	11	48	0	0	21	14
Bivalvia	4	19	0	0	0	52	0	78	17	33
Hydrobiidae	3	18	0	39	21	59	0	0	0	0

Parameter	*n* (areas)	All	Annan	WTWHA	Babinda	Atherton	Herbert	Barratta	Whitsunday	Sarina
Libellulidae	4	18	0	26	0	0	0	100	4	44
Scirtidae	3	18	0	34	47	48	0	0	0	0
Tabanidae	6	17	0	16	21	3	0	78	29	28
Thiaridae	5	17	0	3	0	17	0	67	17	50
Ancylidae	5	14	0	13	0	38	0	56	4	19
Corixidae	5	14	0	3	0	38	0	78	4	25
Helicopsychidae	5	14	0	47	21	7	0	0	13	3
Veliidae	4	13	0	34	0	31	0	33	0	3
Dytiscidae	4	12	0	0	0	7	0	89	4	39
Hydraenidae	4	11	0	37	0	3	0	78	0	3
Corduliidae	5	10	0	21	37	14	0	11	0	3
Gerridae	4	10	0	5	0	10	0	100	0	19
Aeshnidae	4	10	0	29	0	17	0	33	0	3
Eustheniidae	4	10	55	13	11	3	0	0	0	0
Calocidae or Helicophidae	3	9	0	32	5	21	0	0	0	0
Athericidae	4	9	0	32	21	3	0	11	0	0
Hydrobiosidae	5	9	0	16	26	10	0	0	8	6
Conoesucidae	4	8	41	8	11	10	0	0	0	0
Glossosomatidae	5	7	0	13	21	10	0	0	4	6
Gyrinidae	2	7	0	0	0	0	0	0	8	33
Hirudinea	3	7	0	0	0	7	0	0	13	25
Corydalidae	2	6	0	0	0	0	0	0	38	11
Coenagrionidae	2	6	0	0	0	0	0	78	0	14
Helodidae	2	6	50	0	0	0	0	0	0	3
Nematoda	3	6	0	8	0	0	31	0	4	0
Hemicordulidae	2	5	0	0	0	0	0	0	25	14
Polycentropodidae	3	5	0	21	5	7	0	0	0	0
Anura	2	5	0	13	0	0	0	0	0	14
Culicidae	4	5	0	3	0	0	0	33	8	11
Dolichopidae	2	5	0	0	0	0	0	0	25	11
Odontoceridae	2	5	0	21	11	0	0	0	0	0
Amelitopsidae	3	4	0	8	0	0	0	0	8	8
Protoneuridae	2	4	0	0	0	0	0	44	0	11
Anophilini	1	3	0	0	0	0	0	78	0	0
Hydrochidae	1	3	0	0	0	0	0	78	0	0
Lymnaeidae	4	3	0	0	0	3	0	33	4	6
Synlestidae	4	3	0	3	0	14	0	0	4	3
Naucoridae	2	3	0	0	16	0	0	33	0	0

Parameter	*n* (areas)	All	Annan	WTWHA	Babinda	Atherton	Herbert	Barratta	Whitsunday	Sarina
Parastacidae	3	3	0	3	0	14	0	0	0	3
Pleidae	1	3	0	0	0	0	0	67	0	0
Psychodidae	3	2	0	8	0	3	0	0	4	0
Staphylinidae	1	2	0	0	0	0	0	56	0	0
Temnocephalidea	2	2	0	3	0	10	0	0	0	0
Circulionidae	1	1	0	0	0	0	0	33	0	0
Gordiidae	2	1	0	3	0	7	0	0	0	0
Hebridae	2	1	0	3	0	0	0	22	0	0
Notonectidae	2	1	0	0	0	7	0	0	0	3
Telephlebiidae	1	1	0	0	16	0	0	0	0	0
Antipodoeciidae	1	1	0	5	0	0	0	0	0	0
Belostomatidae	1	1	0	0	11	0	0	0	0	0
Carabidae	1	1	0	0	0	0	0	22	0	0
Dixidae	1	1	0	5	0	0	0	0	0	0
Gelacostoridae	1	1	0	0	0	0	0	0	0	6
Haliplidae	2	1	0	0	0	0	0	11	0	3
Hydra	1	1	0	0	0	7	0	0	0	0
Neuroptera	1	1	0	0	0	7	0	0	0	0
Sisyridae	1	1	0	0	0	0	0	22	0	0
Collembola	1	<1	0	0	0	0	0	11	0	0
Hydrometridae	1	<1	0	0	0	0	0	11	0	0
Hygrobiidae	1	<1	0	0	0	0	0	0	0	3
Limnichidae	1	<1	0	0	0	0	0	11	0	0
Mesoveliidae	1	<1	0	0	0	0	0	11	0	0
Prospistomatidae	1	<1	0	3	0	0	0	0	0	0
Ranatridae	1	<1	0	0	0	0	0	11	0	0
Saldidae	1	<1	0	0	0	0	0	11	0	0
Sciomyzidae	1	<1	0	0	0	0	0	11	0	0
Synthemidae	1	<1	0	0	0	0	0	0	0	3
Tasimiidae	1	<1	0	3	0	0	0	0	0	0
Viviparidae	1	<1	0	0	0	0	0	11	0	0
Total number of taxa		103	21	65	45	63	16	57	48	63

Table S3. Results of sequential tests from distance-based linear modelling of invertebrate assemblage data for each environmental variable and each area, showing percentage variation explained separately by each variable in the data ($r^2 \times 100$)

Variables for which $r^2 < 5\%$ and $P > 0.05$ are excluded. AICc, Akaike information criterion adjusted for small sample sizes; max., maximum; min., minimum

Area	Variable	d.f.	AICc	Pseudo-*F*	*P*	r^2 (%)
All	Model					40.3
	Cropping	201	1490.9	24.86	0.001	11
	Conductivity	200	1478.8	14.36	0.001	6
	Litter	199	1468.2	12.90	0.001	5.1
All north	Model					46.8
	Cropping	132	968.0	27.32	0.001	17.1
	Litter	131	958.6	11.74	0.001	6.8
	Forest	130	950.6	10.23	0.001	5.5
All south	Model					39.4
	Season	67	499.9	12.08	0.001	15.3
	Dunder	66	492.9	9.41	0.001	10.6
	Rain total	65	488.5	6.53	0.001	6.8
Annan	Model					22.9
	Mining	20	143.6	5.95	0.003	22.9
WTWHA	Model					29.2
	Rain max. : min. ratio	36	259.9	3.86	0.001	9.7
	Rain total	35	259.0	3.15	0.001	7.5
	Season	34	258.6	2.71	0.004	6.1
	Altitude	33	258.2	2.78	0.001	6
Babinda	Model					43.9
	Forest	17	121.2	8.49	0.002	33.3
	Stones	16	120.8	3.02	0.019	10.6
Atherton	Model					6.8
	pH	27	212.7	1.96	0.047	6.8
Herbert	Model					54.3
	Litter	24	180.6	10.63	0.001	30.7
	Altitude	23	176.3	6.92	0.001	16
	pH	22	175.1	3.64	0.002	7.6
Barrattas	Model					28.5
	Riparian site	7	61.9	2.79	0.050	28.5
Whitsunday	Model					34.7
	Season	22	166.0	4.82	0.001	18.0
	Urban	21	163.2	5.37	0.006	16.7
Sarina	Model					25.1
	Dunder	34	261.4	6.4	0.001	15.8
	Season	33	259.6	4.1	0.003	9.4

Table S4. Results of sequential tests from distance-based linear modelling of invertebrate richness and SIGNAL data for each environmental variable and each area, showing percentage variation explained separately by each variable in the data ($r^2 \times 100$)

Variables for which $r^2 < 5\%$ and $P > 0.05$ are excluded. See Table 2 for variable definitions

Area	Richness						SIGNAL					
	Variable	d.f.	AICc	Pseudo-*F*	*P*	r^2 (%)	Variable	d.f.	AICc	Pseudo-*F*	*P*	r^2 (%)
All	Model	190				38.4	Model total	194				61.8
(n = 203)	Litter	201	1169	14.66	0.001	6.8	Forest	201	888.51	98.94	0.001	33.0
	Mining	200	1158.3	13.03	0.001	5.7	Litter	200	855.07	38.23	0.001	10.8
	Altitude	199	1147.5	13.05	0.001	5.4	Conductivity	199	830.06	28.41	0.001	7.0
All north	Model	125				48.0	Model	121				70.5
(n = 134)	Altitude	132	763.17	30.78	0.001	18.9	Cropping	132	598.89	87.02	0.001	39.7
	Mining	131	750.2	15.59	0.001	8.6	Forest	131	583.46	18.30	0.001	7.4
	Rip u/s	130	736.05	16.79	0.001	8.3	Litter	130	561.28	25.86	0.001	8.8
All south	Model					59.5	Model					72.7
(n = 69)	Season	67	368.48	27.65	0.001	29.2	Season	67	258.03	24.37	0.001	26.7
	Rain total	66	356.57	14.96	0.001	13.1	Conductivity	66	239.23	23.46	0.002	19.2
	Length	65	349.48	9.43	0.002	7.3	Rain total	65	220.2	23.48	0.001	14.4
							pH	64	205	18.52	0.001	8.9
Annan	Model	17				80.5	Model	19				25.9
(n = 22)	Mining	20	117.94	10.62	0.006	34.7						
	Length	19	114.28	6.38	0.015	16.4						
	Latitude	18	101.27	19.30	0.001	25.3						
WTWHA	Model	34				54.8	Model	34				40.0
(n = 38)	Season	36	201.53	16.67	0.001	31.6	Latitude	36	95.917	10.40	0.001	22.4
	Rain total	35	192.22	12.60	0.001	18.1	Season	35	92.126	6.15	0.014	11.6
Babinda	Model	17				51.6	Model	17				42.9
(n = 29)	Rip u/s	17	85.685	18.13	0.001	51.6	Forest	17	44.783	12.76	0.003	42.9
Atherton	Model	26				19.0	Model	24				49.7
(n = 29)	Riparian site	27	160.04	2.64	0.112	8.9	Riparian site	27	138.68	3.98	0.062	12.8
	Stones	26	159.14	3.23	0.049	10.1	Stones	26	133.79	7.55	0.01	19.6
							Latitude	24	130.89	5.34	0.031	11.2
Herbert	Model	22				49.6	Model	20				75.4
(n = 26)	Plants	24	96.67	11.53	0.005	32.5	pH	24	117.22	17.14	0.003	41.7
	Litter	23	95.639	3.42	0.063	8.7	Stones	23	114.31	5.40	0.031	11.1
							Altitude	22	109.28	7.74	0.012	12.3
							Litter	21	107.44	4.40	0.036	6.1
Barratta	Model	7				14.5	Model	5				94.6
(n = 9)							Catchment	7	23.947	8.30	0.028	54.2
							pH	6	18.419	12.90	0.026	31.2
Whitsunday	Model					70.0	Model					45.7
(n = 24)	Grazing	22	119.04	6.14	0.022	21.8	Latitude	22	74.295	5.63	0.022	20.4
	Length	21	110.26	12.78	0.003	29.6	Forest	21	71.415	5.42	0.033	16.3
	Season	20	107.93	4.87	0.026	9.5	Season	20	70.636	3.32	0.088	9.0
	pH	19	104.81	5.76	0.016	9.1						
Sarina	Model					33.0	Model					72.4
(n = 36)	Season	34	184.82	16.75	0.001	33.0	Conductivity	34	128.56	19.45	0.001	36.4
							Season	33	118.89	13.13	0.002	18.1
							Rain total	32	114.04	7.30	0.016	8.5
							pH	31	110.5	5.87	0.023	5.9
							RainVar	30	106.61	6.22	0.025	5.4