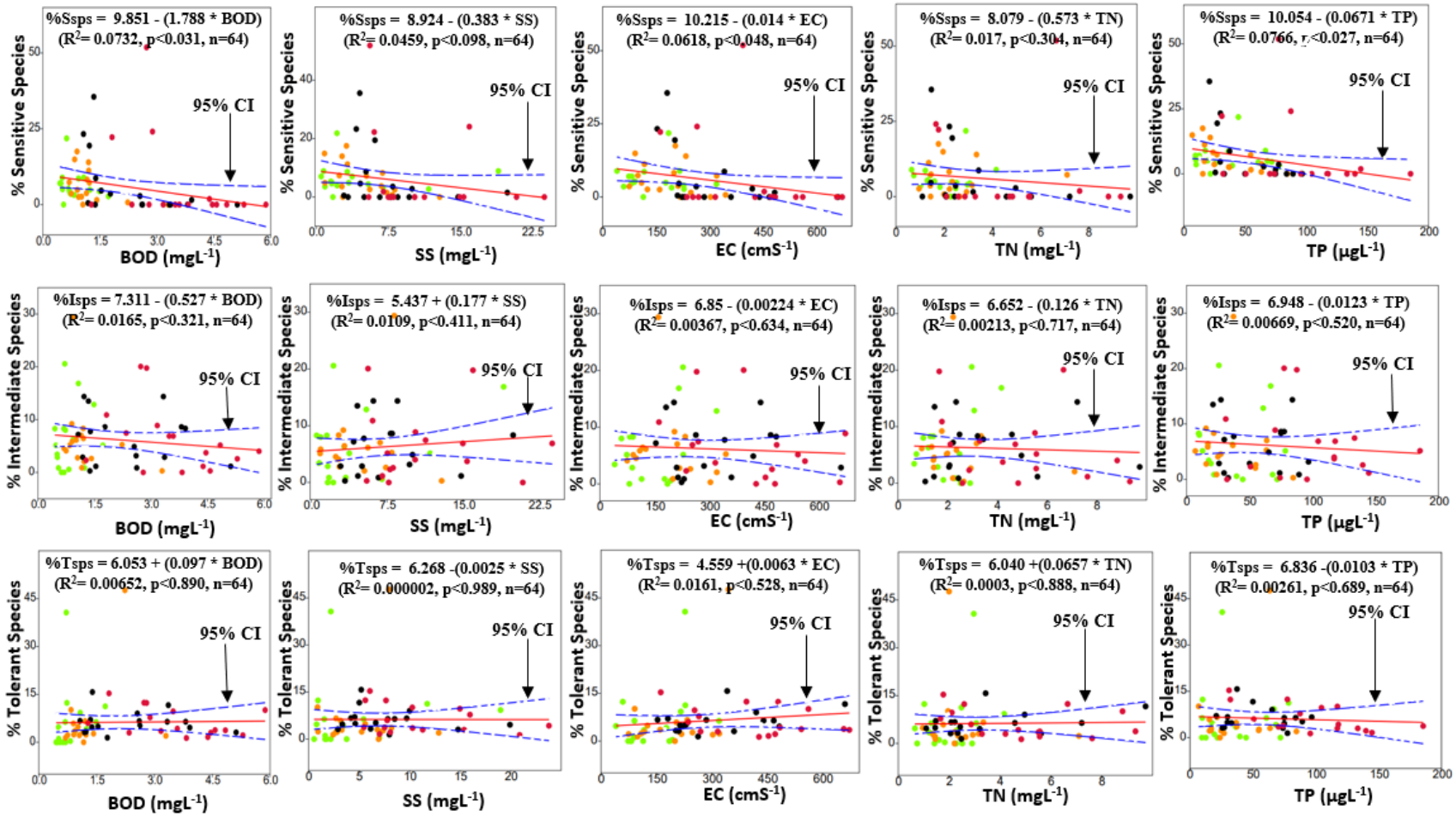

Figure S1. Response of fish tolerance guilds to biological oxygen demand (BOD, mg/L), suspended solids (SS, mg/L), electric conductivity (EC, cm/S), total nitrogen (TN, mg/L) and total phosphorus (TP, µg/L) in each of the foul land-use patterns (green: forest region, orange: agriculture region, black: urban upstream region, red: urban downstream region).

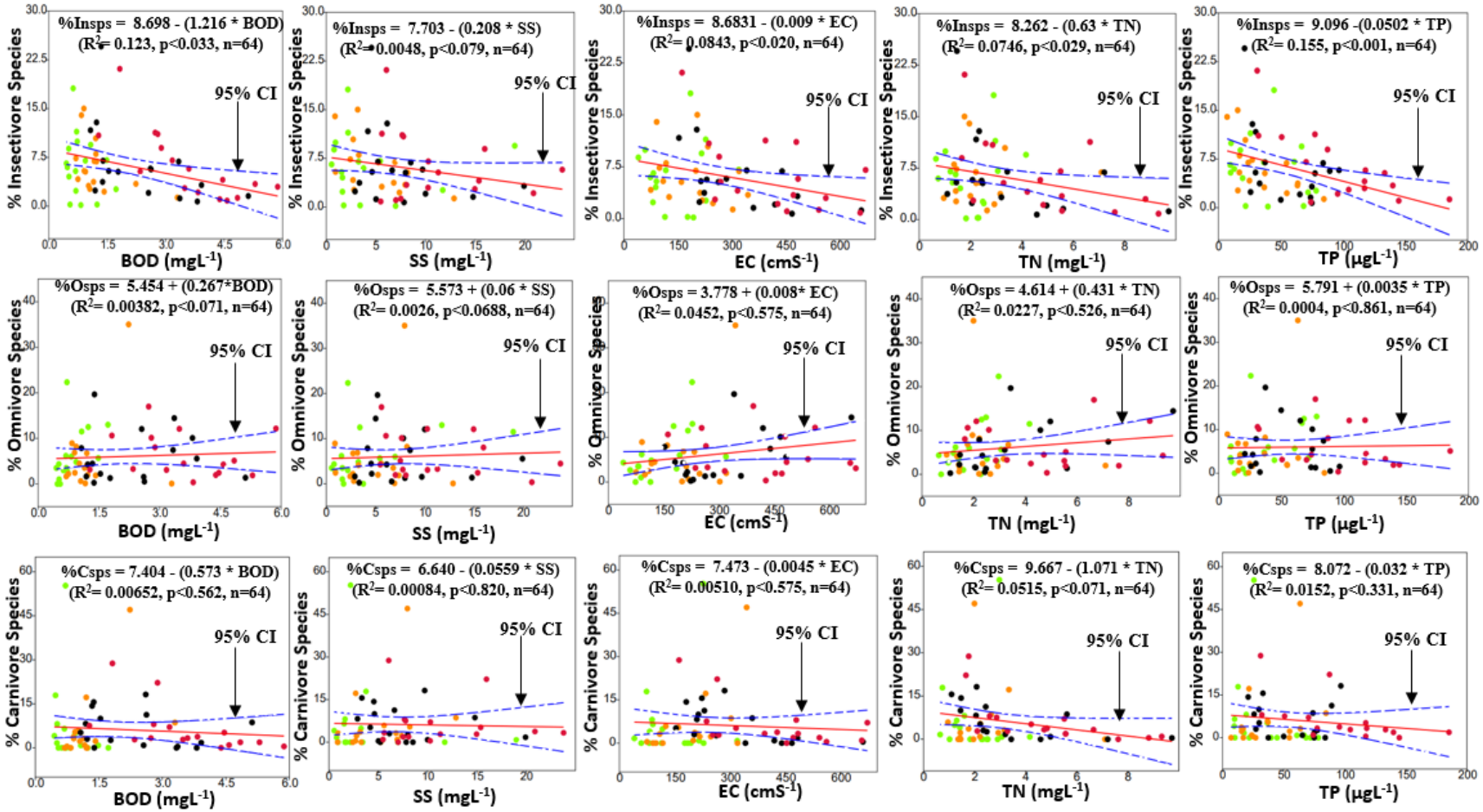

Figure S2. Response of fish trophic guilds to biological oxygen demand (BOD, mg/L), suspended solids (SS, mg/L), electric conductivity (EC, cm/S), total nitrogen (TN, mg/L) and phosphorus (TP, µg/L) in each of the foul land-use patterns (green: forest region, orange: agriculture region, black: urban upstream region, red: urban downstream region).

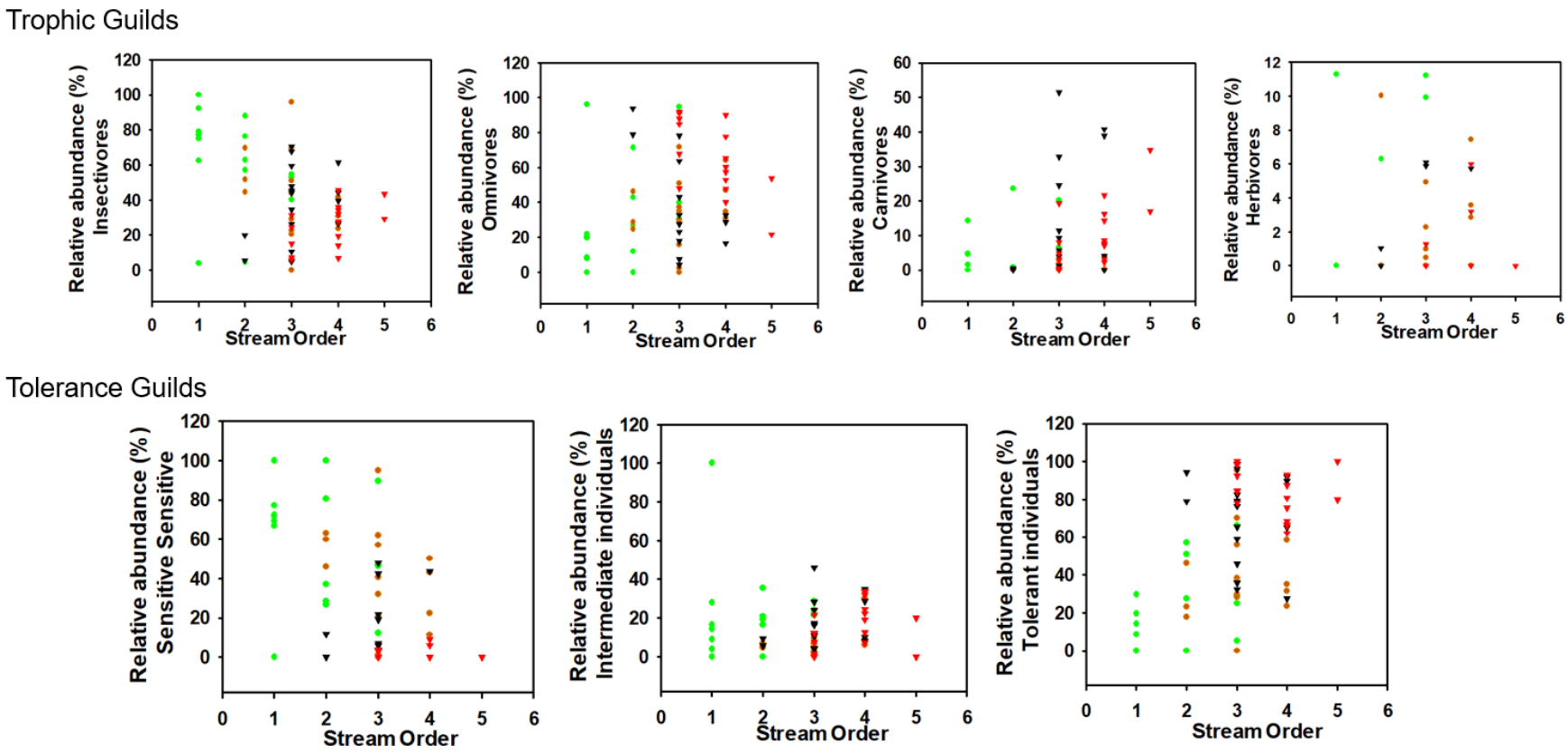

Figure S3. Relations of fish guilds with stream order

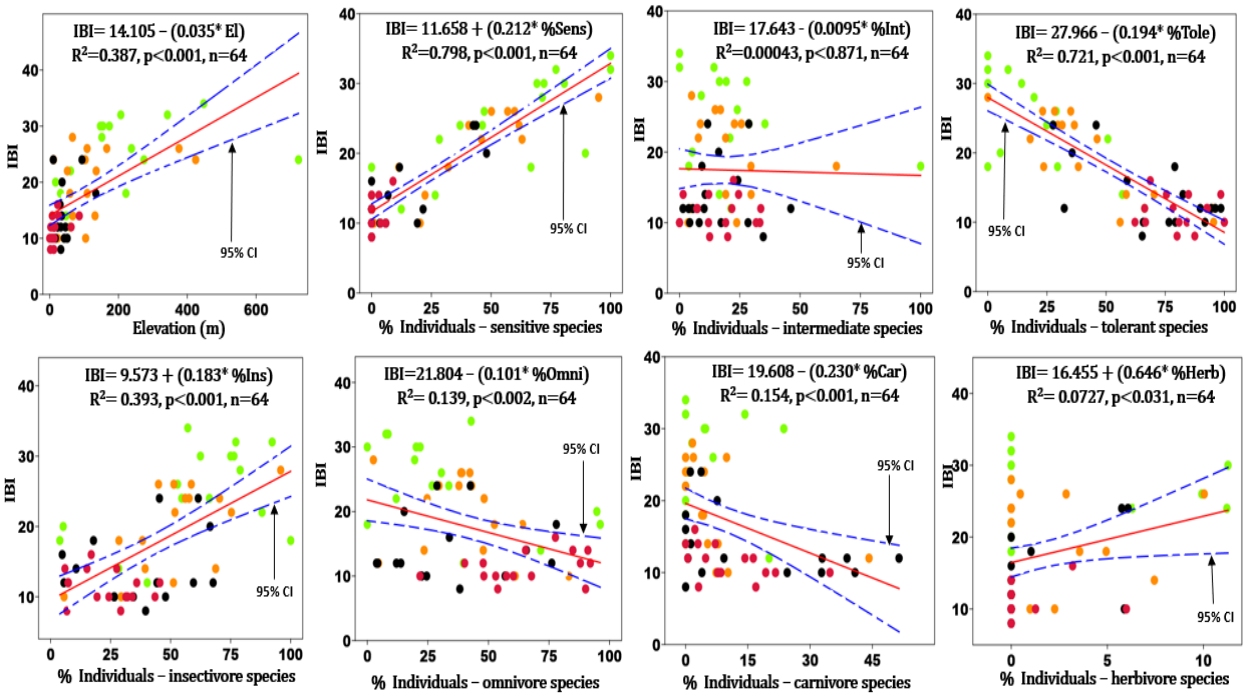

Figure S4. Influence of trophic and tolerance guilds and elevation to IBI.

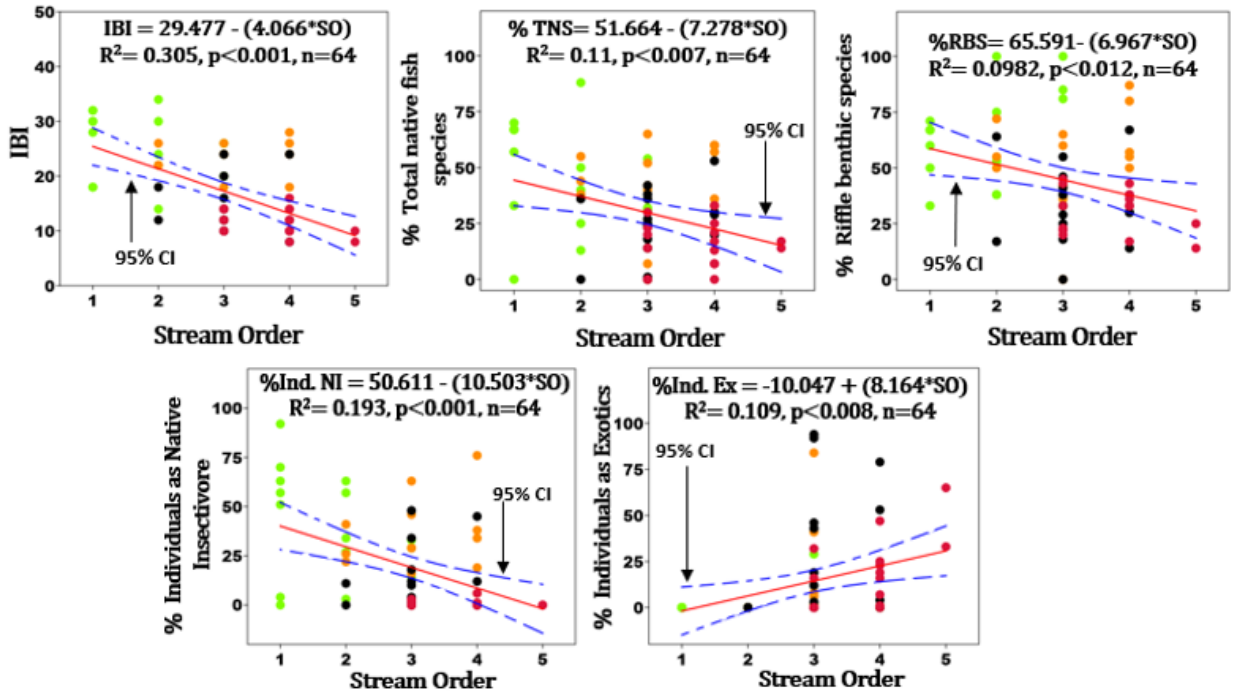

Figure S5. Relations of IBI and relative abundances (%RA) of native species, riffle benthic species, native insectivore individuals and exotic individuals based on the stream orders.

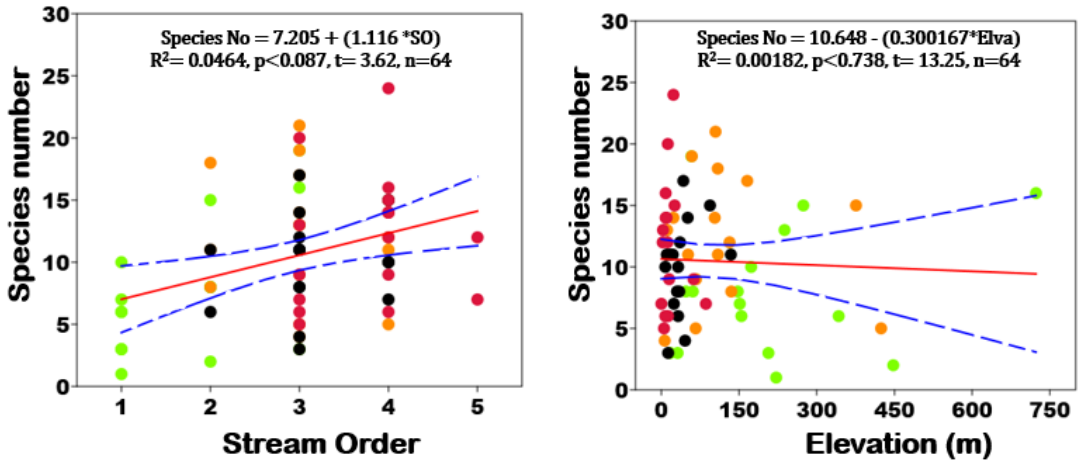

Figure S6. Relationship of fish species number with stream order and elevation

Table S1. Stream sites divided into four land-use patterns and their longitude and latitudes depending on the water and fish data collection sites (Land use patterns; F – Forest region, A – Agriculture region, Uu – Urban upstream region and Ud – Urban downstream region).

Site No:	Stream (original) name	Land use pattern	Coordinates for fish sampling sites	Coordinates for water sampling sites
S1	북천	F	38°08'07.27"N 128°13'57.45"E	38°08'07.27"N 128°13'57.45"E
S2	송천1	F	37°39'10.78"N 128°42'03.32"E	37°39'10.78"N 128°42'03.32"E
S3	창릉천-1	F	37°39'10.41"N 126°56'15.18"E	37°39'10.41"N 126°56'15.18"E
S4	향목동천	F	36°45'00.69"N 127°53'55.46"E	36°46'26.03"N 127°53'12.04"E
S5	가야천	F	35°47'29.03"N 128°05'24".41"E	35°47'09.63N 128°06'15.62"E
S6	소호천	F	35°42'47.75"N 129°42'03.58"E	35°41'43.79"N 129°04'51.43"E
S7	오봉천	F	35°25'55.21"N 127°46'51.00"E	35°26'23.70"N 127°46'27.34"E
S8	위천-1	F	36°10'21.14"N 128°50'20.31"E	36° 9'47.00"N 128°49'40.68"E
S9	상곡천	F	36°12'24.74"N 127°34'08.25"E	36°13'12.14"N 127°34'03.58"E
S10	소양천1	F	35°51'5.44"N 127°13'41.44"E	35°51'12.20"N 127°13'26.59"E
S11	용수천-1	F	36°22'47.06"N 127°15'24.74"E	36°27'19.07"N 127°16'39.19"E
S12	진안천	F	35°47'42.93"N 127°27'28.25"E	35°48'8.32"N 127°31'04.23"E
S13	남천	F	35° 07'50.59"N 127°05'5.20"E	35°07'53.00"N 127°05'30.90"E
S14	석곡천	F	35°13'44.10"N 126°57'39.85"E	35°13'31.31"N 126°57'17.69"E
S15	수어천	F	35° 02'56.53"N 127°41'39.96"E	35° 2'59.98"N 127°41'35.81"E
S16	횡천강	F	35°11'24.55"N 127°47'4.17"E	35°11'32.94"N 127°47'2.26"E
S17	가평천2	A	37°52'59.10"N 127°32'52.88"E	37°53'05.84"N 127°32'38.03"E
S18	골지천2	A	37°27'28.43"N 128°40'41.51"E	37°28'31.02"N 128°43'17.99"E
S19	주천강1	A	37°24'50.33"N 128°09'21.31"E	37°24'50.33"N 128°09'21.31"E

S20	한탄강1	A	38°07'21.87"N 127°15'58.26"E	38°07'28.57"N 127°16'09.16"E
S21	함안천2	A	35°19'30.44"N 128°24'03.29"E	35°19'21.43"N 128°24'03.68"E
S22	용전천3	A	36°29'12.55"N 129°01'22.32"E	36°29'12.55"N 129°01'22.32"E
S23	회천	A	35°52'39.86"N 128°10'34.45"E	35°52'32.17"N 128°10'44.01"E
S24	안동4	A	36°32'23.07"N 128°28'02.68"E	36°32'23.07"N 128°28'02.68"E
S25	무한천1	A	36°34'08.89"N 126°47'07.79"E	36°34'08.89"N 126°47'07.79"E
S26	백천내	A	35°39'32.18"N 126°36'54.50"E	35°39'18.32"N 126°36'46.19"E
S27	봉황천	A	36°06'46.40"N 127°33'13.98"E	36°06'46.40"N 127°33'13.98"E
S28	조평천	A	36°50'30.85"N 127°31'22.85"E	36°50'40.89"N 127°31'17.16"E
S29	보성강-1	A	34°51'35.33"N 127°09'33.13"E	34°51'35.33"N 127°09'33.13"E
S30	북하천	A	35°24'09.93"N 126°54'11.33"E	35°22'47.19"N 126°55'22.76"E
S31	요천10	A	35°20'34.29"N 127°18'18.47"E	35°20'34.29"N 127°18'18.47"E
S32	횡천강2	A	35°04'54.72"N 127°47'53.76"E	35°05'31.30"N 127°47'55.44"E
S33	달천3	Uu	36°52'10.76"N 127°51'21.20"E	36°52'57.02"N 127°51'45.55"E
S34	안양천1-1	Uu	37°22'07.93"N 126°56'55.25"E	37°22'23.95"N 126°56'43.84"E
S35	중랑천1	Uu	37°44'14.22"N 127°3'11.66"E	37°44'14.22"N 127°03'11.66"E
S36	원주천1	Uu	37°20'30.64"N 127°57'48.63"E	37°20'26.19"N 127°57'49.38"E
S37	금호강5	Uu	35°51'28.50"N 128°41'14.66"E	35°51'24.47"N 128°42'18.98"E
S38	영산강	Uu	35°10'53.04"N 128°8'29.45"E	35°9'58.47"N 128°09'11.68"E
S39	양산천1	Uu	35°23'20.78"N 129° 3'1.99"E	35°23'20.78"N 129° 03'1.99"E
S40	형산강1-1	Uu	35°48'51.48"N 129°12'5.13"E	35°48'56.14"N 129°12'1.96"E
S41	갑천1	Uu	36°17'46.55"N 127°21'38.16"E	36°18'22.20"N 127°21'33.23"E
S42	미호천3	Uu	36°46'18.94"N 127°30'34.86"E	36°46'4.55"N 127°30'24.59"E
S43	삼천2	Uu	35°49'52.57"N 127°6'25.63"E	35°50'6.28"N 127°06'21.03"E
S44	전안천1	Uu	36°47'57.97"N 127°8'46.43"E	36°47'57.97"N 127°08'46.43"E
S45	지석천2	Uu	35° 2'54.55"N 126°50'13.71"E	35°2'54.55"N 126°50'13.71"E
S46	우치	Uu	35°14'33.34"N 126°53'19.11"E	35°14'33.34"N 126°53'19.11"E
S47	황룡강1	Uu	35°19'17.04"N 126°47'28.38"E	35°18'33.01"N 126°47'2.87"E
S48	광산(영본B)	Uu	34°54'07.63"N 126°44'08.20"E	35°04'14.28"N 126°46'35.80"E
S49	달천5	Ud	36°59'13.86"N 127°53'21.11"E	36°59'13.86"N 127°53'21.11"E
S50	안양천3	Ud	37°26'20.65"N 126°53'59.86"E	37°26'25.60"N 126°53'58.85"E
S51	중릉천4	Ud	37°32'44.50"N 127°1'55.12"E	37°33'10.04"N 127°2'36.81"E
S52	원주천2	Ud	37°24'46.45"N 127°54'59.95"E	37°25'39.64"N 127°54'58.98"E
S53	금호강6	Ud	35°51'46.83"N 128°28'20.45"E	35°50'31.28"N 128°28'12.33"E
S54	남강2	Ud	35°12'43.51"N 128°7'37.99"E	35°12'28.53"N 128°7'44.71"E
S55	양산천3	Ud	35°17'13.24"N 129°0'41.47"E	35°17'13.24"N 129°0'41.47"E
S56	형산강2	Ud	35°58'52.84"N 129°15'53.02"E	35°58'52.84"N 129°15'53.02"E

S57	갑천5	Ud	36°26'19.36"N 127°23'28.72"E	36°26'16.39"N 127°23'34.05"E
S58	미호천8	Ud	36°39'33.55"N 127°23'0.93"E	36°39'34.69"N 127°23'8.88"E
S59	전주천6	Ud	35°53'21.81"N 127°5'21.51"E	35°52'43.73"N 127°5'47.03"E
S60	전안천2	Ud	36°46'52.09"N 127°6'46.52"E	36°46'52.09"N 127°6'46.52"E
S61	지석천8	Ud	35°3'10.27"N 126°46'31.17"E	35°3'10.27"N 126°46'31.17"E
S62	광주1	Ud	35°9'41.43"N 126°49'25.12"E	35°9'41.43"N 126°49'25.12"E
S63	황룡강3-1	Ud	35°7'21.76"N 126°47'1.20"E	35°7'21.76"N 126°47'1.20"E
S64	죽산(나주)	Ud	34°58'28.62"N 126°37'51.29"E	34°58'28.62"N 126°37'51.29"E

Table S2. Stream sites divided into four land-use patterns and their longitude and latitudes depending on the water and fish data collection sites (Land use patterns; F – Forest region, A – Agriculture region, Uu – Urban upstream region and Ud – Urban downstream region).

Stream No:	Used area (%)	Agricultural (%)	Forest (%)	Total area	Elevation (m)	Species No	Stream original name	Land-use
S1	0.28	6.69	93.03	12558426	237.7	13	북천	F
S2	9.6	14.48	74.91	12565446	723.3	16	송천1	F
S3	17.9	13.16	68.84	12558218	31.4	3	창릉천-1	F
S4	2.46	28.21	68.58	12558737	154.5	6	향목동천	F
S5	6.84	3.29	89.86	12561188	447.8	2	가야천	F
S6	0.93	6.46	92.61	12558184	342.3	6	소호천	F
S7	3.09	24.54	70.71	12561375	147.5	8	오봉천	F
S8	1.28	12.26	85.75	12559934	206.7	3	위천-1	F
S9	1.13	14.87	84	12558488	221.6	1	상곡천	F
S10	6.14	33.02	58.3	12558233	57.9	19	소양천1	F
S11	10.24	50.6	36.4	12558126	17.1	3	용수천-1	F
S12	1.04	6.36	92.59	12560042	274	15	진안천	F
S13	2.93	19.47	74.79	12558812	173.4	10	남천	F
S14	10.18	49.65	37.51	12565278	47.6	8	석곡천	F
S15	1.67	10.04	87.36	12563562	60.7	8	수어천	F
S16	1.21	8.22	90.57	12558472	151.5	7	횡천강	F
S17	7.57	29.48	62.61	12558484	103	14	가평천2	A
S18	4	23.34	72.66	12558170	375.8	15	골지천2	A
S19	3.39	29.56	65.52	12559342	424.3	5	주천강1	A
S20	4.82	49.61	44.15	12563446	109.1	11	한탄강1	A
S21	6.17	58.06	31.58	12558111	6.4	4	함안천2	A
S22	3.49	31.01	64.19	12569083	165.8	17	용전천3	A
S23	6.06	45.11	46.46	12558129	108.8	18	회천	A
S24	6.17	68.45	18.19	12558109	66.1	5	안동4	A

S25	7.15	55.07	36.75	12558873	23.2	14	무한천1	A
S26	1.35	9.47	88.8	1954076	51.5	11	백천내	A
S27	8.22	53.39	35.59	12558133	131.7	12	봉황천	A
S28	5.58	31.39	57.94	12565073	66.8	9	조평천	A
S29	2.83	38.48	54.32	12558119	104.6	21	보성강-1	A
S30	2.26	15.97	81.37	12558910	135	8	북하천	A
S31	8.55	74.83	9.62	12558231	58.8	19	요천10	A
S32	4.05	25.71	70.15	12568847	10.9	13	횡천강2	A
S33	5.4	40.77	50	12558342	93.9	15	달천3	Uu
S34	88.27	0.23	11.36	12558136	32.3	6	안양천1-1	Uu
S35	73.37	4.15	22.09	12558128	34.4	8	중랑천1	Uu
S36	54.24	27.55	15.86	12558157	134.1	11	원주천1	Uu
S37	40.73	37.84	12.61	12559633	32.3	10	금호강5	Uu
S38	11.72	71.94	14.98	12560139	16.7	11	영산강	Uu
S39	20.03	24.86	54.23	12560360	10.3	11	양산천1	Uu
S40	12.71	65.31	18.43	12561343	35.9	12	형산강1-1	Uu
S41	40.89	17.94	37.97	12568468	50.9	14	갑천1	Uu
S42	7.96	59.34	29.01	12558296	42.4	17	미호천3	Uu
S43	62.33	13.28	18.87	12568271	21.9	11	삼천2	Uu
S44	76.37	14.2	8.65	12558135	30.2	8	전안천1	Uu
S45	14.91	70.13	12.69	12558773	13.1	3	지석천2	Uu
S46	6.65	79.88	7.3	12566475	24.1	7	우치	Uu
S47	20.77	45.84	27.55	12558456	45.7	4	황룡강1	Uu
S48	5.9	75.88	12.3	12561520	7.6	10	광산(영본B)	Uu
S49	8.03	81.67	1.83	12558299	62.2	9	달천5	Ud
S50	10.97	54.13	32.3	6214981	7.6	6	안양천3	Ud
S51	64.14	7.68	28.16	12558223	3.1	13	중릉천4	Ud
S52	98.17	0.12	1.53	12560042	85.9	7	원주천2	Ud
S53	4.02	28.71	65.72	12558172	10.1	14	금호강6	Ud
S54	40.05	33.88	16.62	12558234	12.5	20	남강2	Ud
S55	21.17	58.52	16.88	12563126	0	7	양산천3	Ud
S56	17.88	49.35	27.85	12559681	5.2	5	형산강2	Ud
S57	10.03	39.69	43.7	11415911	23.2	24	갑천5	Ud
S58	54.07	12.28	31.53	12558114	25.6	15	미호천8	Ud
S59	17.27	70.01	11.08	12571015	12.8	6	전주천6	Ud
S60	20.82	73.91	1.04	12570345	14.9	9	전안천2	Ud
S61	31.07	38.55	29.16	12561611	8.2	16	지석천8	Ud
S62	42.7	45.02	3.72	12558108	11.9	12	광주1	Ud
S63	52.23	43.2	0.03	12559745	8.2	14	황룰강3-1	Ud
S64	4.4	78.72	15.3	12558224	2.4	12	죽산(나주)	Ud