

*Ecosphere*

**Magnesium and zinc stable isotopes as a new tool to understand Mg and Zn sources in  
stream food webs**

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**Appendix S1**

Table S1. Total number of fish and aquatic macroinvertebrate samples with respect to stream name, location, and sampling month.

Stream	Location	Month	Number of samples n
Ado	Upper	May	10
		November	11
	Lower	May	9
		November	10
Yasu	Upper	May	11
		November	6
	Lower	May	10
		November	9

Table S2. Physicochemical characteristics of stream water.

Stream	Location	Month	Watershed area <sup>a</sup> (km <sup>2</sup> )	Elevation (m)	Temp (°C)	EC (μS/cm)	pH
Ado	Upper	May	25.4	417	12.1	49	7.7
		November			12.0	53	7.8
	Lower	May	298.5	109	15.1	63	7.7
		November			16.6	73	8.0
Yasu	Upper	May	4.2	503	10.2	53	7.3
		November			11.4	65	8.1
	Lower	May	294.7	147	18.5	104	7.7
		November			17.3	120	8.8

<sup>a</sup>from Ishikawa et al. (2014)

Table S3.  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , and the major elemental concentrations of filtered (0.2  $\mu\text{m}$ ) stream water. Note that Al, Fe and Zn are reported in  $\mu\text{g/L}$ .

Stream	Location	Month	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	$\delta^{66}\text{Zn}_{\text{JMC}}$ mean $\pm 2\sigma$	Mg	Ca	Na	K	Si	Al	Fe	Zn
			(‰)	(‰)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	( $\mu\text{g/L}$ )	( $\mu\text{g/L}$ )	( $\mu\text{g/L}$ )
Yasu	Upper	May	$-0.78 \pm 0.02$	$0.27 \pm 0.00$	0.55	5.08	3.00	0.40	3.93	51.4	3.1	4.2
		November	$-0.90 \pm 0.01$	$0.29 \pm 0.02$	0.68	6.69	3.11	0.51	4.79	4.5	1.7	2.7
	Lower	May	$-0.87 \pm 0.04$	$0.26 \pm 0.04$	2.06	8.78	5.97	1.80	5.72	44.7	45.9	0.6
		November	$-0.80 \pm 0.08$	$0.19 \pm 0.04$	2.33	10.26	7.29	1.78	6.39	4.4	10.8	0.6
Ado	Upper	May	$-0.60 \pm 0.07$	$0.31 \pm 0.03$	1.07	3.88	2.92	0.41	3.96	4.7	11.7	0.5
		November	$-0.73 \pm 0.10$	$0.29 \pm 0.01$	1.13	3.95	2.78	0.46	3.70	3.4	14.5	0.9
	Lower	May	$-0.95 \pm 0.03$	$0.33 \pm 0.01$	1.39	4.59	4.35	0.56	3.85	6.9	2.1	0.4
		November	$-0.94 \pm 0.12$	$0.18 \pm 0.01$	1.54	5.47	4.39	0.63	3.70	5.8	3.6	1.2

Table S4.  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , Mg and Zn concentrations, and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of periphyton.

Stream	Location	Month	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	Mg	$\delta^{66}\text{Zn}_{\text{JMC}}$ mean $\pm 2\sigma$	Zn	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
			(‰)	(mg/g)	(‰)	(mg/g)	(‰)	(‰)
Ado	Upper	May	$-0.62 \pm 0.08$	0.51	$0.56 \pm 0.01$	0.04	-17.3	-0.7
		November	$-0.81 \pm 0.05$	0.65	$0.61 \pm 0.01$	0.03	-19.5	-0.4
	Lower	May	$-0.77 \pm 0.03$	0.65	$0.47 \pm 0.02$	0.03	-15.3	2.3
		November	$-0.90 \pm 0.13$	0.68	$0.58 \pm 0.01$	0.02	-14.9	3.0
Yasu	Upper	May	$-0.74 \pm 0.05$	0.37	$0.36 \pm 0.01$	0.08	-14.7	-2.9
		November	$-0.78 \pm 0.07$	0.74	$0.30 \pm 0.02$	0.03	-15.8	-1.8
	Lower	May	$-0.60 \pm 0.10$	0.89	$0.30 \pm 0.04$	0.10	-20.4	4.3
		November	$-0.85 \pm 0.03$	0.54	$0.35 \pm 0.01$	0.07	-17.2	5.1

Table S5.  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , Mg and Zn concentrations, and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of plant litter.

Stream	Location	Month	Family	Scientific name	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	Mg	$\delta^{66}\text{Zn}_{\text{IMC}}$ mean $\pm 2\sigma$	Zn	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
					(‰)	(mg/g)	(‰)	(mg/g)	(‰)	(‰)
Ado	Upper	May	Fagaceae	<i>Quercus salicina</i>	$-1.03 \pm 0.06$	0.78	$-0.62 \pm 0.02$	0.01	-30.9	-2.1
Ado	Upper	May	Fagaceae	<i>Fagus crenata</i>	$-0.61 \pm 0.06$	0.85	$0.00 \pm 0.06$	0.04	-29.6	-1.9
Ado	Upper	May	Sapindaceae	<i>Acer mono var ambiguum</i>	$-0.54 \pm 0.06$	0.99	$0.18 \pm 0.04$	0.02	-30.3	-2.7
Ado	Upper	November	Rosaceae	<i>Sorbus alnifolia</i>	$-0.94 \pm 0.03$	2.00	$0.25 \pm 0.03$	0.12	-30.9	0.3
Ado	Upper	November	Sapindaceae	<i>Acer diabolicum</i>	$-0.91 \pm 0.10$	2.00	$-0.04 \pm 0.03$	0.12	-29.3	-2.9
Ado	Upper	November	Lauraceae	<i>Lindera umbellata</i>	$-1.05 \pm 0.04$	1.49	$-0.01 \pm 0.02$	0.06	-32.0	-2.3
Ado	Lower	May	Fagaceae	<i>Quercus myrsinaefolia</i>	$-0.80 \pm 0.04$	0.97	$-0.34 \pm 0.01$	0.01	-29.4	-2.4
Ado	Lower	November	Salicaceae	<i>Salix integra</i>	$-0.76 \pm 0.05$	0.81	$-0.19 \pm 0.00$	0.02	-31.7	-2.2
Ado	Lower	November	Rosaceae	<i>Sorbus alnifolia</i>	$-0.80 \pm 0.03$	1.54	$0.06 \pm 0.01$	0.03	-29.9	-2.5
Ado	Lower	November	Lauraceae	<i>Lindera umbellata</i>	$-0.80 \pm 0.06$	1.07	$0.15 \pm 0.03$	0.03	-30.5	-0.5
Yasu	Upper	May	Fagaceae	<i>Quercus salicina</i>	$-1.28 \pm 0.12$	0.52	$-0.43 \pm 0.01$	0.02	-31.7	-2.8
Yasu	Upper	May	Fagaceae	<i>Fagus crenata</i>	$-0.74 \pm 0.06$	0.43	$0.18 \pm 0.01$	0.08	-29.8	-2.3
Yasu	Upper	May	Ulmaceae	<i>Ulmus davidiana var. Japonica</i>	$-0.77 \pm 0.09$	0.62	$0.05 \pm 0.03$	0.13	-29.0	-5.2
Yasu	Upper	November	Eupteleaceae	<i>Euptelea polyandra</i>	$-1.19 \pm 0.05$	0.95	$-0.06 \pm 0.04$	0.02	-31.4	-2.9
Yasu	Upper	November	Cercidiphyllaceae	<i>Cercidiphyllum japonicum</i>	$-1.19 \pm 0.12$	0.98	$-0.37 \pm 0.01$	0.08	-29.2	-4.8
Yasu	Upper	November	Fagaceae	<i>Fagus japonica</i>	$-0.93 \pm 0.08$	0.63	$-0.41 \pm 0.00$	0.02	-31.4	-3.4
Yasu	Lower	May	Fagaceae	<i>Quercus myrsinaefolia</i>	$-1.25 \pm 0.11$	0.99	$-0.22 \pm 0.05$	0.02	-28.7	0.0
Yasu	Lower	November	Salicaceae	<i>Salix integra</i>	$-0.70 \pm 0.03$	1.67	NA	0.12	-30.5	0.3
Yasu	Lower	November	Oleaceae	<i>Ligustrum japonicum</i>	$-0.73 \pm 0.07$	1.51	$0.25 \pm 0.00$	0.02	-28.4	1.5
Yasu	Lower	November	Lauraceae	<i>Lindera umbellata</i>	$-0.93 \pm 0.09$	0.89	$-0.29 \pm 0.01$	0.03	-31.0	0.0

Table S6.  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , Mg and Zn concentrations, and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of aquatic macroinvertebrates.

Stream	Location	Month	Specimen	Scientific name	Feeding habits	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	Mg	$\delta^{66}\text{Zn}_{\text{JMC}}$ mean $\pm 2\sigma$	Zn	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
						(‰)	(mg/g)	(‰)	(mg/g)	(‰)	(‰)
Ado	Upper	May	Japanese Freshwater Crab*	<i>Geothelphusa dehaani</i>	Collector-gatherer	$-0.98 \pm 0.03$	7.22	ND	0.01	-16.9	0.4
Ado	Upper	May	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.65 \pm 0.06$	0.93	$0.40 \pm 0.02$	0.16	-21.4	3.1
Ado	Upper	May	Crane fly	Tipulidae	Shredder	$-0.38 \pm 0.05$	0.75	$0.59 \pm 0.01$	0.12	-27.7	-0.8
Ado	Upper	May	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.29 \pm 0.04$	1.37	$0.35 \pm 0.06$	0.27	-19.8	1.6
Ado	Upper	May	Mayfly	Heptageniidae spp.	Grazer	$-0.15 \pm 0.01$	1.56	$0.42 \pm 0.01$	0.23	-17.5	1.1
Ado	Upper	May	Caddisfly	Rhyacophilidae	Predator	$-0.71 \pm 0.11$	1.32	$0.42 \pm 0.01$	0.45	-21.2	3.4
Ado	Upper	May	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.32 \pm 0.04$	2.00	$0.55 \pm 0.02$	0.15	-18.9	3.2
Ado	Upper	May	Stonefly	<i>Oyamia</i> spp.	Predator	$-0.62 \pm 0.08$	2.85	$0.66 \pm 0.02$	0.14	-20.7	3.6
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	Predator	$0.77 \pm 0.01$	0.86	$0.34 \pm 0.02$	0.14	-20.3	4.1
Ado	Upper	November	Japanese Freshwater Crab*	<i>Geothelphusa dehaani</i>	Collector-gatherer	$-1.05 \pm 0.09$	11.52	ND	0.06	ND	ND
Ado	Upper	November	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.63 \pm 0.10$	1.25	$0.47 \pm 0.05$	0.18	-22.8	2.8
Ado	Upper	November	Caddisfly	<i>Stenopsyche marmorata</i>	Filter-feeder	$-0.71 \pm 0.12$	1.16	$0.75 \pm 0.04$	0.11	-24.1	2.0
Ado	Upper	November	Crane fly	Tipulidae	Shredder	$-0.68 \pm 0.10$	0.99	$0.42 \pm 0.06$	0.09	-28.2	-0.5
Ado	Upper	November	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.38 \pm 0.07$	1.17	$0.43 \pm 0.03$	0.15	-21.8	2.1
Ado	Upper	November	Mayfly	Heptageniidae spp.	Grazer	$-0.27 \pm 0.07$	1.32	$0.46 \pm 0.03$	0.16	-19.2	1.7
Ado	Upper	November	Caddisfly	Rhyacophilidae	Predator	$-0.68 \pm 0.04$	3.09	ND		ND	ND
Ado	Upper	November	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.33 \pm 0.10$	1.41	$0.49 \pm 0.04$	0.17	-22.5	3.1

Ado	Upper	November	Stonefly	<i>Oyamia</i> spp.	Predator	$-0.48 \pm 0.09$	2.78	$0.69 \pm 0.01$	0.21	-20.1	2.8
Ado	Upper	November	Dragonfly	Gomphidae spp.	Predator	$-0.31 \pm 0.10$	0.65	$0.20 \pm 0.03$	0.13	-22.1	4.1
Ado	Upper	November	Dobsonfly	<i>Protohermes grandis</i>	Predator	$0.33 \pm 0.07$	1.35	$0.29 \pm 0.05$	0.16	-20.5	2.9
Ado	Lower	May	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.77 \pm 0.07$	1.20	$0.45 \pm 0.03$	0.17	-18.4	5.6
Ado	Lower	May	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.49 \pm 0.07$	1.26	$0.25 \pm 0.02$	0.12	-18.9	5.6
Ado	Lower	May	Mayfly	Heptageniidae spp.	Grazer	$-0.36 \pm 0.08$	1.52	$0.39 \pm 0.01$	0.20	-17.5	4.5
Ado	Lower	May	Caddisfly	Rhyacophilidae	Predator	$-0.73 \pm 0.02$	1.37	$0.35 \pm 0.04$	0.36	-17.5	6.5
Ado	Lower	May	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.95 \pm 0.05$	2.25	$0.42 \pm 0.03$	0.13	-18.4	5.8
Ado	Lower	May	Stonefly	<i>Oyamia</i> spp.	Predator	$-0.99 \pm 0.05$	3.78	$0.56 \pm 0.02$	0.22	-18.4	4.8
Ado	Lower	May	Dragonfly	Gomphidae spp.	Predator	$-0.14 \pm 0.01$	1.26	$0.03 \pm 0.00$	0.15	-18.1	5.7
Ado	Lower	May	Dobsonfly	<i>Protohermes grandis</i>	Predator	$0.38 \pm 0.05$	0.77	$0.35 \pm 0.02$	0.11	-19.4	6.1
Ado	Lower	November	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.61 \pm 0.05$	0.89	$0.57 \pm 0.04$	0.12	-17.6	4.1
Ado	Lower	November	Caddisfly	<i>Stenopsyche marmorata</i>	Filter-feeder	$-0.96 \pm 0.08$	0.89	$0.63 \pm 0.06$	0.09	-19.4	3.8
Ado	Lower	November	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.59 \pm 0.02$	1.44	$0.46 \pm 0.04$	0.12	-20.1	4.2
Ado	Lower	November	Mayfly	Heptageniidae spp.	Grazer	$-0.56 \pm 0.02$	1.69	$0.49 \pm 0.01$	0.13	-18.5	4.0
Ado	Lower	November	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.85 \pm 0.02$	1.31	$0.53 \pm 0.03$	0.19	-18.2	4.8
Ado	Lower	November	Stonefly	<i>Oyamia</i> spp.	Predator	$-0.94 \pm 0.07$	3.14	$0.56 \pm 0.02$	0.20	-17.2	5.5
Ado	Lower	November	Dragonfly	Gomphidae spp.	Predator	$-0.33 \pm 0.05$	1.11	$0.05 \pm 0.03$	0.14	-21.3	4.3
Ado	Lower	November	Dobsonfly	<i>Protohermes grandis</i>	Predator	$0.03 \pm 0.04$	1.47	$0.41 \pm 0.04$	0.15	-17.0	2.3
Ado	Lower	November	Shrimp*	Atyidae spp.	Omnivore	$-1.40 \pm 0.03$	0.94	$0.41 \pm 0.04$	0.05	-20.6	10.9
Yasu	Upper	May	Japanese Freshwater Crab*	<i>Geothelphusa dehaani</i>	Collector-gatherer	$-1.05 \pm 0.05$	8.89	ND	0.01	-20.5	-2.5

Yasu	Upper	May	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.56 \pm 0.08$	1.35	$0.29 \pm 0.01$	0.22	-24.8	-0.1
Yasu	Upper	May	Crane fly	Tipulidae	Shredder	$-0.56 \pm 0.07$	0.88	$0.55 \pm 0.02$	0.13	-28.0	-1.5
Yasu	Upper	May	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.49 \pm 0.12$	0.98	$0.20 \pm 0.01$	0.47	-21.8	-1.2
Yasu	Upper	May	Mayfly	Heptageniidae spp.	Grazer	$-0.62 \pm 0.04$	0.90	$0.28 \pm 0.03$	0.34	-26.4	-2.2
Yasu	Upper	May	Caddisfly	Rhyacophilidae	Predator	$-0.70 \pm 0.05$	1.21	$0.22 \pm 0.02$	0.34	-25.2	0.9
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.66 \pm 0.02$	1.47	$0.26 \pm 0.02$	0.18	-25.1	1.0
Yasu	Upper	May	Stonefly	<i>Oyamia</i> spp.	Predator	$-0.57 \pm 0.05$	2.06	$0.22 \pm 0.04$	0.23	-26.1	1.0
Yasu	Upper	May	Dragonfly	Gomphidae spp.	Predator	$-0.36 \pm 0.05$	0.54	$0.02 \pm 0.02$	0.11	-27.0	2.3
Yasu	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	Predator	$0.18 \pm 0.02$	0.94	$0.17 \pm 0.04$	0.15	-26.1	1.6
Yasu	Upper	November	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.89 \pm 0.08$	1.22	$0.31 \pm 0.02$	0.23	-24.6	0.0
Yasu	Upper	November	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.40 \pm 0.02$	1.09	$0.28 \pm 0.01$	0.45	-20.3	-1.4
Yasu	Upper	November	Mayfly	Heptageniidae spp.	Grazer	$-0.53 \pm 0.13$	1.16	$0.19 \pm 0.05$	0.43	-23.1	-1.4
Yasu	Upper	November	Caddisfly	Rhyacophilidae	Predator	$-1.03 \pm 0.12$	1.35	$-0.06 \pm 0.04$	0.24	-23.7	1.4
Yasu	Upper	November	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.66 \pm 0.08$	1.76	$0.40 \pm 0.03$	0.25	-23.4	0.7
Yasu	Lower	May	Caddisfly	Hydropsychidae spp.	Filter-feeder	$-0.76 \pm 0.01$	0.96	$0.28 \pm 0.01$	0.11	-23.3	7.3
Yasu	Lower	May	Caddisfly	<i>Stenopsyche marmorata</i>	Filter-feeder	$-0.79 \pm 0.03$	0.86	$0.42 \pm 0.03$	0.09	-22.7	6.5
Yasu	Lower	May	Mayfly	<i>Baetis</i> spp.	Grazer	$-0.27 \pm 0.08$	1.17	$0.17 \pm 0.01$	0.36	-23.1	5.5
Yasu	Lower	May	Mayfly	Heptageniidae spp.	Grazer	$-0.24 \pm 0.05$	1.35	$0.00 \pm 0.02$	0.48	-21.9	7.0
Yasu	Lower	May	Caddisfly	Rhyacophilidae	Predator	$-0.75 \pm 0.04$	1.40	$0.08 \pm 0.04$	0.30	-21.7	8.3
Yasu	Lower	May	Stonefly	<i>Kamimuria</i> spp.	Predator	$-0.47 \pm 0.08$	1.04	$0.27 \pm 0.03$	0.17	-21.5	9.2
Yasu	Lower	May	Dragonfly	Gomphidae spp.	Predator	$-0.03 \pm 0.02$	0.81	$-0.05 \pm 0.01$	0.14	-20.5	8.9



Yasu	Lower	May	Dobsonfly	<i>Protohermes grandis</i>	Predator	0.31 ± 0.04	0.89	0.21 ± 0.02	0.14	-22.4	8.2
Yasu	Lower	May	Shrimp*	Atyidae spp.	Omnivore	-1.23 ± 0.03	1.05	0.08 ± 0.03	0.05	-22.8	8.6
Yasu	Lower	November	Caddisfly	Hydropsychidae spp.	Filter-feeder	-0.81 ± 0.08	1.16	0.34 ± 0.01	0.14	-19.5	6.3
Yasu	Lower	November	Caddisfly	<i>Stenopsyche marmorata</i>	Filter-feeder	-0.69 ± 0.04	1.81	0.48 ± 0.05	0.12	-20.2	5.7
Yasu	Lower	November	Mayfly	<i>Baetis</i> spp.	Grazer	-0.21 ± 0.16	1.00	0.25 ± 0.04	0.29	-20.9	5.9
Yasu	Lower	November	Mayfly	Heptageniidae spp.	Grazer	-0.43 ± 0.11	1.19	0.13 ± 0.03	0.26	-18.0	6.5
Yasu	Lower	November	Stonefly	<i>Kamimuria</i> spp.	Predator	-0.73 ± 0.01	0.93	0.27 ± 0.01	0.21	-21.0	8.9
Yasu	Lower	November	Dragonfly	Gomphidae spp.	Predator	-0.08 ± 0.03	0.91	-0.01 ± 0.01	0.11	-23.2	7.1
Yasu	Lower	November	Dobsonfly	<i>Protohermes grandis</i>	Predator	0.16 ± 0.04	1.20	0.19 ± 0.02	0.13	-20.5	6.8
Yasu	Lower	November	Shrimp*	Atyidae spp.	Omnivore	-1.46 ± 0.07	1.13	0.34 ± 0.03	0.05	-21.5	7.5

\*shells

Table S7.  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , Mg and Zn concentrations, and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of fish bones and muscles.

Stream	Location	Month	Specimen	Scientific name	Sample type	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	$\delta^{66}\text{Zn}$ mean $\pm 2\sigma$	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
						(‰)	(‰)	(‰)	(‰)
Ado	Upper	May	Chub	<i>Rhynchocypris oxycephalus jouyi</i>	bone	$-0.64 \pm 0.04$	ND	ND	ND
					muscle	ND*	$0.16 \pm 0.01$	6.4	-20.8
Ado	Upper	November	-	-	-	-	-	-	-
					-	-	-	-	-
Ado	Lower	May	Goby	<i>Rhinogobius kurodai</i>	bone	$-1.07 \pm 0.05$	ND	ND	ND
					muscle	ND	$0.31 \pm 0.04$	9.0	-16.0
Ado	Lower	November	Goby	<i>Rhinogobius kurodai</i>	bone	$-0.58 \pm 0.04$	ND	ND	ND
					muscle	$-0.62 \pm 0.19$	$0.20 \pm 0.04$	8.8	-16.1
Yasu	Upper	May	Goby	<i>Cottus pollux</i>	bone	$-0.77 \pm 0.03$	ND	ND	ND
					muscle	ND	$0.04 \pm 0.04$	2.5	-20.7
Yasu	Upper	November	Goby	<i>Cottus pollux</i>	bone	$-0.75 \pm 0.10$	ND	ND	ND
					muscle	$-0.74 \pm 0.06$	$-0.06 \pm 0.01$	2.2	-20.4
Yasu	Lower	May	Goby	<i>Rhinogobius kurodai</i>	bone	$-1.03 \pm 0.12$	ND	ND	ND
					muscle	$-1.14 \pm 0.09$	$0.14 \pm 0.04$	11.2	-20.5
Yasu	Lower	November	Goby	<i>Rhinogobius kurodai</i>	bone	$-1.03 \pm 0.07$	ND	ND	ND
					muscle	$-1.04 \pm 0.04$	$0.08 \pm 0.01$	10.4	-18.3

\*ND: not determined

Table S8. Biomass,  $\delta^{26}\text{Mg} \pm 2\sigma$ ,  $\delta^{66}\text{Zn} \pm 2\sigma$ , Mg and Zn concentrations, and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of single individuals of *Protohermes grandis* and *Kamimuria* spp.

Stream	Location	Month	Specimen	Scientific name	Biomass	$\delta^{26}\text{Mg}$ mean $\pm 2\sigma$	Mg	$\delta^{66}\text{Zn}$ mean $\pm 2\sigma$	Zn	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
					(mg)	(‰)	(mg/g)	(‰)	(mg/g)	(‰)	(‰)
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	3.9	-0.27 $\pm$ 0.07	1.80	0.44 $\pm$ 0.07	0.19	-22.9	3.2
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	10.6	0.31 $\pm$ 0.07	1.41	0.50 $\pm$ 0.02	0.13	-21.8	2.2
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	27.2	0.29 $\pm$ 0.01	1.50	0.33 $\pm$ 0.03	0.18	-22.4	2.9
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	68.9	-0.01 $\pm$ 0.04	1.37	0.37 $\pm$ 0.01	0.16	-22.0	3.1
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	142.4	0.33 $\pm$ 0.07	1.35	0.26 $\pm$ 0.05	0.16	-20.5	2.9
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	207.7	0.11 $\pm$ 0.03	1.41	0.28 $\pm$ 0.01	0.18	-23.1	3.1
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	348.3	0.45 $\pm$ 0.02	0.98	0.42 $\pm$ 0.04	0.16	-22.5	4.4
Ado	Upper	May	Dobsonfly	<i>Protohermes grandis</i>	478.7	0.77 $\pm$ 0.01	0.86	0.31 $\pm$ 0.02	0.14	-20.3	4.1
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	5.8	-0.63 $\pm$ 0.05	1.23	0.29 $\pm$ 0.05	0.21	-22.3	0.1
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	8.0	-0.82 $\pm$ 0.07	1.02	0.43 $\pm$ 0.07	0.29	-22.5	0.3
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	14.7	-0.78 $\pm$ 0.02	1.25	0.35 $\pm$ 0.01	0.30	-22.1	0.3
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	20.2	-0.72 $\pm$ 0.05	1.23	0.41 $\pm$ 0.07	0.23	-23.2	0.1
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	32.4	-0.64 $\pm$ 0.02	1.29	0.41 $\pm$ 0.03	0.25	-23.4	0.4
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	42.4	-0.70 $\pm$ 0.06	1.24	0.40 $\pm$ 0.03	0.24	-23.1	0.2
Yasu	Upper	May	Stonefly	<i>Kamimuria</i> spp.	53.5	-0.47 $\pm$ 0.02	2.47	0.28 $\pm$ 0.05	0.17	-24.9	0.3

\*ND: not determined

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