

1 **Supplemental Information**

2 **Scavenging amphipods from the Wallaby-Zenith Fracture Zone: Extending the hadal**
3 **paradigm beyond subduction trenches**

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Table S1. Number of amphipods recovered by species and depth from the Zenith Plateau and Wallaby-Zenith Fracture Zone, and the Afanasy Nikitin Seamount. The asterisks indicate potentially undescribed species.

		Zenith Plateau & Wallaby-Zenith Fracture Zone						Afanasy Nikitin Seamount	
Depth (m)		4932	5990	6068	6162	6537	6546	4733	4757
Family	Species	Counts							
Alicellidae	<i>Alicella gigantea</i> Chevreux, 1899	1	-	-	-	-	-	1	-
	<i>Civifractura serendipia</i> Weston, Peart, & Jamieson 2020	31	-	-	-	-	-	-	-
	<i>Paralicella caperesca</i> Shulenberg & Barnard, 1976	48	11	1	6	13	-	39	43
	<i>Paralicella tenuipes</i> Chevreux, 1908	517	1167	92	492	246	341	23	14
Cyclocaridae	<i>Cyclocaris</i> sp.*	2	11	1	2	2	4	9	17
Eurytheneidae	<i>Eurythenes maldoror</i> d'Udekem d'Acoz & Havermans, 2015	80	1	-	7	4	7	-	11
Eusiridae	<i>Cleonardo</i> sp.*	-	-	-	1	-	-	-	-
Hirondelleidae	<i>Hirondellea</i> sp.*	-	-	-	-	-	-	2	-
Scopelocheiridae	<i>Bathycallisoma schellenbergi</i> Birstein & Vinogradov, 1958	-	-	-	-	130	523	-	-
Valettipsidae	<i>Valettietta</i> sp.*	5	1	-	-	-	1	-	-
Uristidae	<i>Abyssorchomene distinctus</i> (Birstein & Vinogradov, 1960)	-	-	-	-	-	-	1	43
	<i>Abyssorchomene gerulicorbis</i> (Shulenberg & Barnard, 1976)	-	9	2	2	4	74	-	-
	<i>Stephonyx sigmacrus</i> Weston, Peart, & Jamieson 2020	23	-	-	-	-	-	-	-
No. Individuals		707	1200	96	510	399	950	75	128
No. Species		8	6	4	6	6	6	6	5
Shannon Diversity Index		1.97	1.56	1.25	1.61	1.68	1.63	1.73	1.60

22 Table S2. Species, location and depth (m), and 16S and COI sequence accession numbers for
 23 amphipods from the Wallaby-Zenith Fracture Zone (WZFFZ) and Afanasy Nikitin Seamount
 24 (ANS) added to GenBank by this study and Weston et al. 2020.

Species	Location	Depth (m)	16S	COI
<i>Abyssorchomene distinctus</i>	ANS	4757	MN251311	MN262162
<i>Abyssorchomene gerulicorbis</i>	WZFFZ	5990	MN251312	MN262163
<i>Abyssorchomene gerulicorbis</i>	WZFFZ	6546	MN251313	MN262164
<i>Alicella gigantea</i>	ANS	4733	MK503195	MK503205
<i>Alicella gigantea</i>	WZFFZ	4932	MK503196	MK503206
<i>Bathycallisoma schellenbergi</i>	WZFFZ	6537	MN251314	MN262165
<i>Bathycallisoma schellenbergi</i>	WZFFZ	6537	MN251315	MN262166
<i>Bathycallisoma schellenbergi</i>	WZFFZ	6546	MN251316	MN262167
<i>Bathycallisoma schellenbergi</i>	WZFFZ	6546	MN251317	MN262168
<i>Bathycallisoma schellenbergi</i>	WZFFZ	6546	MN251318	MN262169
<i>Civifractura serendipia</i>	WZFFZ	4932	MK503197	MK503208
<i>Civifractura serendipia</i>	WZFFZ	4932	MK503198	MK503209
<i>Cleonardo</i> sp.	WZFFZ	6162	MN251319	MN262170
<i>Cyclocaris</i> sp.	WZFFZ	5990	MN251320	No amp
<i>Eurythenes maldoror</i>	ANS	4757	MN251321	MN262171
<i>Eurythenes maldoror</i>	WZFFZ	4932	MN251322	MN262172
<i>Eurythenes maldoror</i>	WZFFZ	4932	MN251323	MN262173
<i>Eurythenes maldoror</i>	WZFFZ	4932	MN251324	MN262174
<i>Eurythenes maldoror</i>	WZFFZ	6162	MN251325	MN262175
<i>Eurythenes maldoror</i>	WZFFZ	6537	MN251326	No amp
<i>Eurythenes maldoror</i>	WZFFZ	6546	MN251327	MN262176
<i>Hirondellea</i> sp.	ANS	4733	MN251328	No amp.
<i>Paralicella caperesca</i>	ANS	4757	MN251329	MN262177
<i>Paralicella caperesca</i>	ANS	4757	MN251330	No amp
<i>Paralicella caperesca</i>	WZFFZ	4932	MN251331	MN262178
<i>Paralicella tenuipes</i>	WZFFZ	5990	MN251332	MN262179
<i>Paralicella tenuipes</i>	WZFFZ	4932	MN251333	MN262180
<i>Paralicella tenuipes</i>	WZFFZ	6537	MN251334	MN262181
<i>Valettietta</i> sp.	WZFFZ	4932	MN251335	MN262182

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26 Table S3. Species, sequence accession numbers and references for all samples included in the
 27 analysis of the *Bathycallisoma schellenbergi* dataset. WZFZ abbreviation for the Wallaby-Zenith
 28 Fracture Zone.

Species	16S	COI	Location	Reference
<i>B. schellenbergi</i>	KP308148	KP713939	Kermadec Trench	Ritchie et al. 2015
<i>B. schellenbergi</i>	KP456060	KP713938	New Hebrides Trench	Ritchie et al. 2015
<i>B. schellenbergi</i>	KP456061	KP713937	New Hebrides Trench	Ritchie et al. 2015
<i>B. schellenbergi</i>	MN251314	MN262165	WZFZ	This study
<i>B. schellenbergi</i>	MN251318	MN262169	WZFZ	This study
<i>B. schellenbergi</i>	MN251316	MN262167	WZFZ	This study
<i>B. schellenbergi</i>	MN251317	MN262168	WZFZ	This study
<i>B. schellenbergi</i>	MF598980	MF598998	Massau Trench	Chan et al. unpublished
<i>B. schellenbergi</i>	MF598979	MF598997	Massau Trench	Chan et al. unpublished
<i>B. schellenbergi</i>	MF598978	MF598994	Massau Trench	Chan et al. unpublished
<i>B. schellenbergi</i>	AY256969	AY256968	Tonga Trench	Blankenship et al. unpublished
<i>Hirondellea dubia</i>	KP456071	KP713902	New Hebrides Trench	Ritchie et al. 2015
<i>Hirondellea gigas</i>	KP456077	KP713911	Japan Trench	Ritchie et al. 2015

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Table S4. SIMPER analysis of amphipod abundance with species-level identifications in the Zenith Plateau and Wallaby-Zenith Fracture Zone (WZFFZ), Afanasy Nikitin Seamount (ANS), Kermadec Trench (KT), New Hebrides Trench (NHT), South Fiji Basin (SFB), and Peru-Chile Trench (PCT). The (dis)similarities between Cluster 4 (WZFFZ & ANS) and the five other cluster groups identified by SIMPROF are presented by increasing dissimilarity with percentage contribution of each species that counts for >90% of that value.

Cluster 4 – WZFFZ & ANS		
(Similarity 57.23)		
Cluster 4 – WZFFZ & ANS	Species	%
	<i>Paralicella tenuipes</i>	45.55
	<i>Paralicella caperesca</i>	17.5
	<i>Cyclocaris</i> sp.	17.32
(Dissimilarity 71.88)		
Cluster 6 - NHT Bathyal & Abyssal	Species	%
	<i>Paralicella tenuipes</i>	17.70
	<i>Abyssorchomene abyssorum</i>	10.91
	<i>Eurythenes gryllus</i>	9.53
	<i>Abyssorchomene gerulicorbis</i>	7.38
	<i>Eurythenes maldoror</i>	6.39
	<i>Cyclocaris</i> sp.	6.26
	<i>Paracallisoma</i> sp.	6.05
Cluster 5 - KT Bathyal & Abyssal	<i>Bathycallisoma schellenbergi</i>	6.02
	(Dissimilarity 73.62)	
	Species	%
	<i>Paralicella tenuipes</i>	23.07
	<i>Cyclocaris</i> sp.	9.16
	<i>Eurythenes maldoror</i>	7.58
	<i>Abyssorchomene distinctus</i>	7.39
	<i>Bathycallisoma schellenbergi</i>	6.88
Cluster 3 - PCT Abyssal	<i>Abyssorchomene musculosus</i>	6.60
	<i>Paralicella caperesca</i>	6.36
	<i>Abyssorchomene gerulicorbis</i>	5.61
	(Dissimilarity 78.32)	
	Species	%
	<i>Paralicella tenuipes</i>	15.44
	<i>Abyssorchomene chevreuxi</i>	13.24
	<i>Eurythenes</i> sp. abyssal	7.94
Cluster 2 – KT & NHT Hadal	<i>Cyclocaris</i> sp.	7.67
	<i>Eurythenes maldoror</i>	6.40
	<i>Paralicella caperesca</i>	5.72
	<i>Abyssorchomene gerulicorbis</i>	5.50
	<i>Bathycallisoma schellenbergi</i>	4.82
	<i>Abyssorchomene distinctus</i>	4.77
	(Dissimilarity 86.23)	
	Species	%
Cluster 1 - PCT Hadal	<i>Paralicella tenuipes</i>	21.53
	<i>Hirondellea dubia</i>	16.96
	<i>Bathycallisoma schellenbergi</i>	13.95
	<i>Paralicella caperesca</i>	9.55
	<i>Cyclocaris</i> sp.	8.95
(Dissimilarity 97.52)		
Cluster 1 - PCT Hadal	Species	%
	<i>Paralicella tenuipes</i>	17.66
	<i>Eurythenes</i> sp. hadal	14.64
	<i>Hirondellea thursoni</i>	11.65
	<i>Paralicella caperesca</i>	9.64
	<i>Cyclocaris</i> sp.	7.98
	<i>Eurythenes maldoror</i>	6.56
Cluster 1 - PCT Hadal	<i>Abyssorchomene gerulicorbis</i>	5.75

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38 Table S5. SIMPER analysis of amphipod abundance with genus-level identifications showing the
 39 (dis)similarities within and between the two cluster groups identified by SIMPROF.

Cluster A		Cluster B	
(Similarity 60.01)		(Dissimilarity 80.42)	
Cluster A - Bathyal to Abyssal and Hadal Trough	Genus	Genus	%
	<i>Paralicella</i>	<i>Hirondellea</i>	18.92
	<i>Abyssochromene</i>	<i>Paralicella</i>	17.92
		<i>Abyssochromene</i>	15.69
		<i>Bathycallisoma</i>	14.97
		<i>Eurythenes</i>	10.96
		(Similarity 55.63)	
Cluster B – Hadal Trench	Genus	Genus	%
		<i>Hirondellea</i>	60.70
		<i>Bathycallisoma</i>	30.69

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41 Table S6. Total counts of juveniles, intersex, females, and males for *Bathycallisoma*
 42 *schellenbergi* from the Wallaby-Zenith Fracture Zone and results of a one-tailed binomial test to
 43 determine significant bias in ratios.

Depth (m)	Juvenile	Intersex	Female	Male	Male: Female Ratio	Mature: Juvenile Ratio
6537	64	1	43	21	0.49*	1.02 ^{ns}
6546	303	0	103	117	1.14 ^{ns}	0.72**

ns: non-significant, *p < 0.01, **p < 0.001

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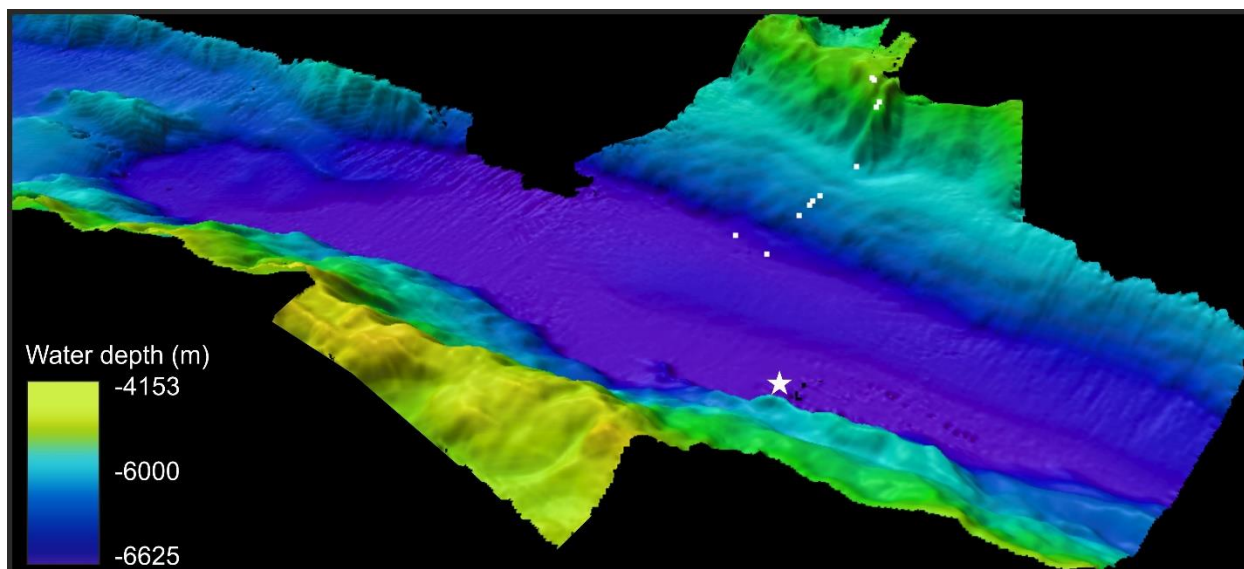


Figure S1. Perspective view of the Wallaby Zenith Fracture Zone looking north with x4 vertical exaggeration. White squares indicate lander deployment sites, white star indicates deepest point. Multibeam bathymetric data acquired during *R/V SONNE* Expedition SO258 (Werner et al. 2017).

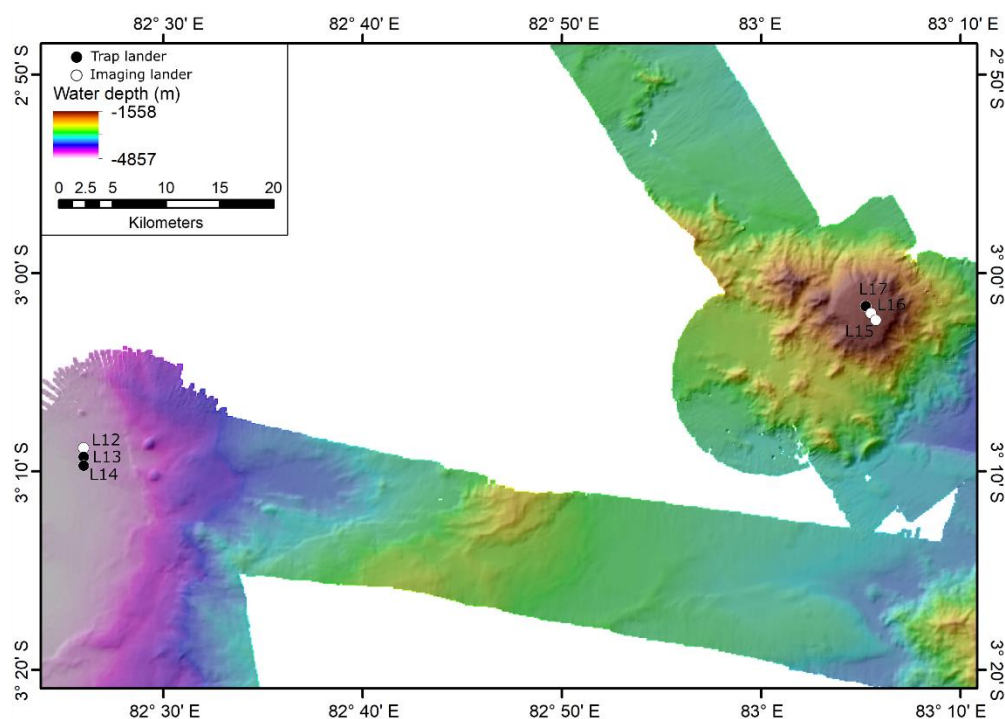


Figure S2. Map of Afanasy Nikitin Seamount with multibeam bathymetric data acquired during *R/V SONNE* Expedition SO258 (Werner et al. 2017). Trap lander deployments indicated

by black circles. Imaging lander deployments indicated by white circles. Only sites L12-14 were included in this study.



Figure S3. Representative images from the imaging landers showing seafloor characteristics and associated fauna from (A) Afanasy Nikitin Seamount (ANS) including *Barathrites iris* Zugmayer, 1911, hermit crab, and small decapods, (B) Zenith Plateau (ZP) with prominent manganese nodules, *Bassozetus* sp., brittle star, and c.f. *Cerataspis monstrosus* Gray, 1828, and Wallaby-Zenith Fracture Zone (WZFZ) (C) with *Eurythenes maldoror* d'Udekem d'Acoz & Havermans, 2015 and (D) *Bassozetus* spp.

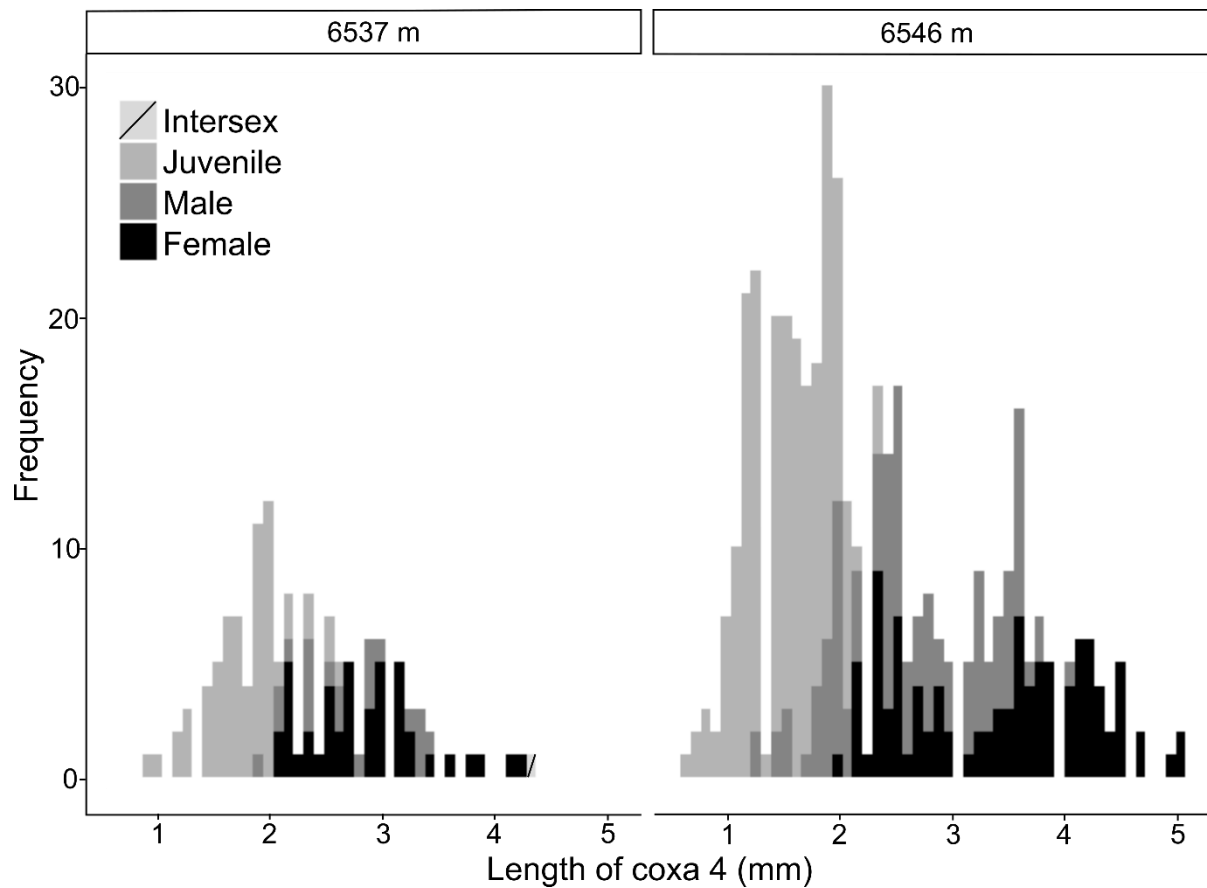


Figure S4. Frequency of coxa 4 length of intersex, juvenile, male, and female *Bathycallisoma schellenbergi* from 6537 and 6546 m at the Wallaby-Zenith Fracture Zone.