

# Leaf litter morphological traits, saprophagous macroarthropods body mass and phylogenetic affiliation explain their feeding behavior and faeces properties.

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**Table 1** – Differences in leaf litter properties between the four tree species. Microbial D= mass loss due to microbial activity only (from control microcosms, n=15), WHC= Water Holding Capacity. Small case letter indicate significant differences between species after Tukey post-hoc test on the one-way ANOVA.

Trait	Litter species			
	<i>A. monspessulanum</i>	<i>A. unedo</i>	<i>Q. ilex</i>	<i>Q. pubescens</i>
C:N ratio	24.1 ± 0.7 <sup>a</sup>	92.4 ± 6.4 <sup>b</sup>	49.9 ± 2.7 <sup>c</sup>	53.6 ± 5.3 <sup>c</sup>
C:P ratio	216.3 ± 14.1 <sup>a</sup>	4360.8 ± 349.2 <sup>b</sup>	6715.2 ± 803.4 <sup>c</sup>	487.6 ± 46.4 <sup>a</sup>
Ca (mg.g <sup>-1</sup> )	18.4 ± 3.7 <sup>ab</sup>	21.6 ± 6.7 <sup>ab</sup>	15.0 ± 3.2 <sup>a</sup>	30.2 ± 10.3 <sup>b</sup>
Tannins (%)	1.4 ± 0.3 <sup>a</sup>	4.3 ± 1.1 <sup>b</sup>	1.0 ± 0.1 <sup>a</sup>	0.9 ± 0.2 <sup>a</sup>
Microbial decomposition (%)	8.0 ± 1.8 <sup>a</sup>	0.9 ± 3.1 <sup>b</sup>	3.6 ± 3.0 <sup>bc</sup>	5.8 ± 5.2 <sup>ac</sup>
WHC (%)	144.9 ± 23.6 <sup>a</sup>	67.4 ± 6.1 <sup>c</sup>	90.6 ± 20.5 <sup>bc</sup>	122.2 ± 30.7 <sup>ab</sup>
Thickness (µm)	173.3 ± 15.3 <sup>a</sup>	317.4 ± 48.2 <sup>b</sup>	370.3 ± 37.2 <sup>c</sup>	232.5 ± 40.5 <sup>d</sup>
SLA (g.mm <sup>-2</sup> )	112.5 ± 23.9 <sup>a</sup>	70.2 ± 23.7 <sup>b</sup>	55.6 ± 11.6 <sup>b</sup>	108.8 ± 23.1 <sup>a</sup>
Curliness (mm)	14.4 ± 4.3 <sup>a</sup>	7.9 ± 2.1 <sup>b</sup>	7.3 ± 3.7 <sup>b</sup>	14.7 ± 5.6 <sup>a</sup>
Tubularity	0.2 ± 0.1 <sup>a</sup>	0.5 ± 0.1 <sup>b</sup>	0.1 ± 0.1 <sup>c</sup>	0.1 ± 0.1 <sup>c</sup>
3-Dimensionality (mm <sup>2</sup> .cm <sup>-3</sup> )	6.2 ± 0.3 <sup>a</sup>	27.6 ± 1.4 <sup>b</sup>	28.4 ± 0.9 <sup>b</sup>	6.3 ± 0.4 <sup>a</sup>

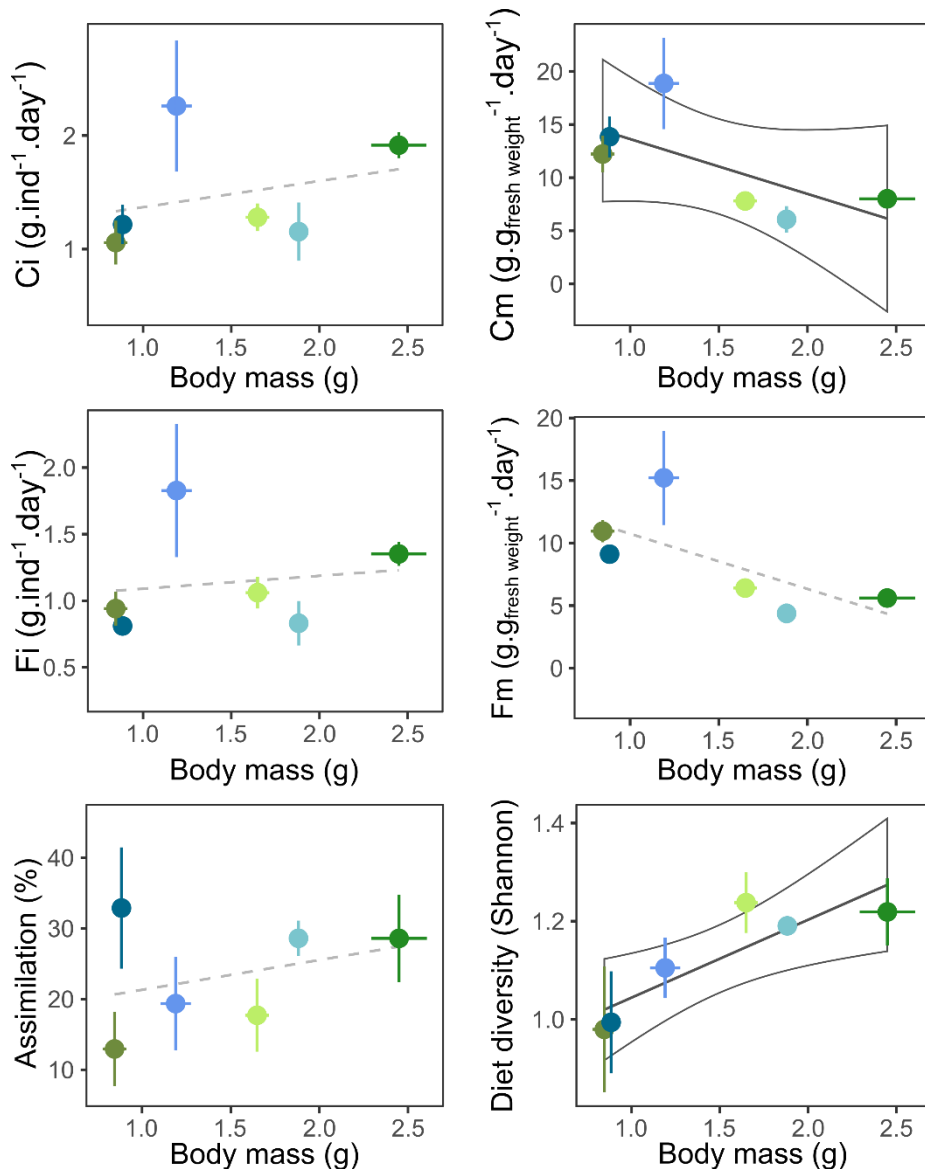
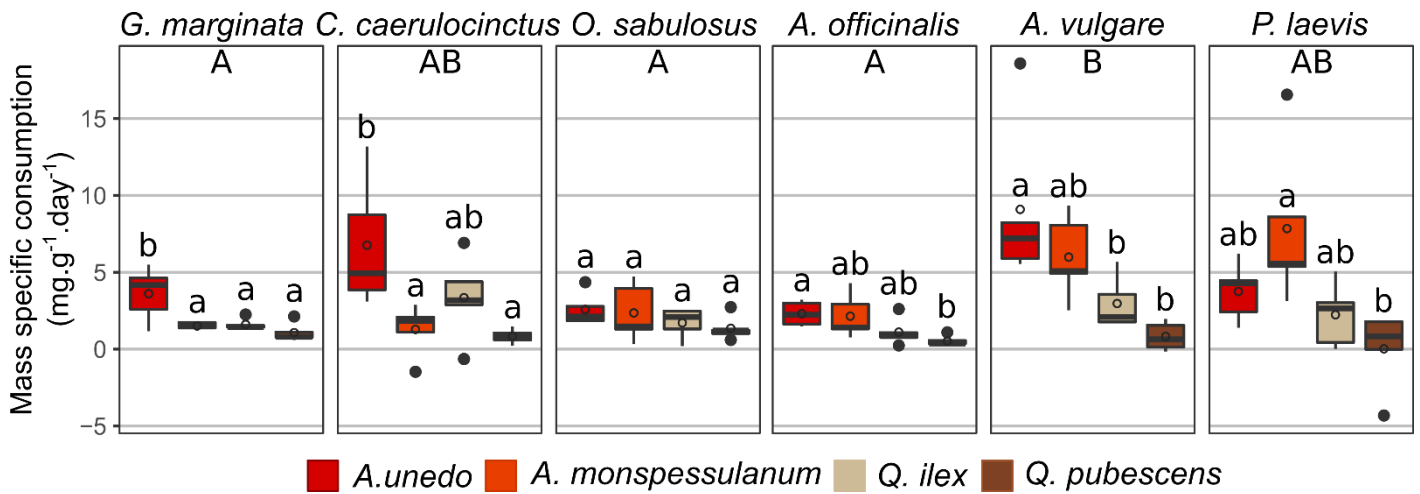
**Table 2** – Saprophagous macroarthropod traits averaged from the five microcosms. Ci and Cm= individual and mass-specific consumption rate, H= diet diversity Fi and Fm = individual and mass-specific faeces production rate, A= assimilation rate. Small case letter indicate significant differences between species after Tukey post-hoc test.

Traits	Species						Class	
	<i>A. officinalis</i>	<i>A. vulgare</i>	<i>P. laevis</i>	<i>G. marginata</i>	<i>C. caerulocinctus</i>	<i>O. sabulosus</i>	Malacostraca	Diplopoda
Fresh body mass (g)	0.19 ± 0.01 <sup>a</sup>	0.12 ± 0.02 <sup>b</sup>	0.09 ± 0.01 <sup>b</sup>	0.16 ± 0.01 <sup>a</sup>	0.08 ± 0.02 <sup>b</sup>	0.24 ± 0.04 <sup>c</sup>	1.32 ± 0.45 <sup>a</sup>	1.67 ± 0.71 <sup>a</sup>
Ci (mg ind <sup>-1</sup> day <sup>-1</sup> )	1.15 ± 0.57 <sup>a</sup>	2.26 ± 1.29 <sup>a</sup>	1.22 ± 0.39 <sup>a</sup>	1.28 ± 0.27 <sup>a</sup>	1.06 ± 0.43 <sup>a</sup>	1.91 ± 0.25 <sup>a</sup>	1.54 ± 0.94 <sup>a</sup>	1.42 ± 0.48 <sup>a</sup>
Cm (mg g <sup>fresh weight</sup> <sup>-1</sup> day <sup>-1</sup> )	6.07 ± 2.78 <sup>c</sup>	18.87 ± 9.63 <sup>a</sup>	13.85 ± 4.33 <sup>ab</sup>	7.81 ± 1.69 <sup>bc</sup>	12.22 ± 3.89 <sup>ab</sup>	8.01 ± 1.85 <sup>bc</sup>	12.93 ± 7.99 <sup>a</sup>	9.35 ± 3.25 <sup>a</sup>
H (Shannon index)	1.19 ± 0.03 <sup>a</sup>	1.10 ± 0.14 <sup>a</sup>	0.99 ± 0.23 <sup>a</sup>	1.24 ± 0.14 <sup>a</sup>	0.98 ± 0.29 <sup>a</sup>	1.22 ± 0.15 <sup>a</sup>	1.1 ± 0.17 <sup>a</sup>	1.15 ± 0.22 <sup>a</sup>
Fi (mg ind <sup>-1</sup> day <sup>-1</sup> )	0.83 ± 0.37 <sup>b</sup>	1.83 ± 1.12 <sup>a</sup>	0.81 ± 0.17 <sup>b</sup>	1.06 ± 0.27 <sup>ab</sup>	0.94 ± 0.29 <sup>ab</sup>	1.35 ± 0.20 <sup>ab</sup>	1.16 ± 0.8 <sup>a</sup>	1.12 ± 0.3 <sup>a</sup>
Fm (mg g <sup>fresh weight</sup> <sup>-1</sup> day <sup>-1</sup> )	4.37 ± 1.79 <sup>d</sup>	15.22 ± 8.43 <sup>a</sup>	9.11 ± 1.24 <sup>abc</sup>	6.40 ± 1.28 <sup>bcd</sup>	10.95 ± 1.99 <sup>ab</sup>	5.60 ± 1.12 <sup>cd</sup>	9.57 ± 6.54 <sup>a</sup>	7.65 ± 2.81 <sup>a</sup>
A (%)	26.2 ± 7.8 <sup>a</sup>	19.1 ± 15.3 <sup>a</sup>	32.1 ± 19.4 <sup>a</sup>	16.7 ± 11.6 <sup>a</sup>	10.9 ± 10.5 <sup>a</sup>	28.3 ± 14.3 <sup>a</sup>	1.06 ± 0.43 <sup>a</sup>	1.91 ± 0.25 <sup>a</sup>

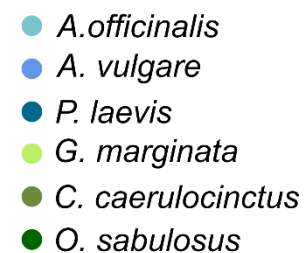
**Table 3** - ANOVA table of linear regression between litter preference by saprophagous macroarthropods (proportion of the litter type in the animal diet) and each litter properties. SS: sum of square, F: F statistic with degree of freedom

	SS	F <sub>1,22</sub>	pval
C:N ratio	593,1	2,6	0,12
C:P ratio	95,2	0,4	0,54
Ca content	181,0	0,7	0,40
<b>Tannins content</b>	<b>2515,4</b>	<b>17,8</b>	<b>&lt;0.001</b>
Thickness	31,2	0,1	0,73
SLA	277,0	1,1	0,30
WHC	616,4	2,7	0,11
<b>Tubularity</b>	<b>2497,9</b>	<b>17,5</b>	<b>&lt;0.001</b>
Curliness	686,1	3,1	0,09
3-Dimensionality	681,3	3,0	0,10

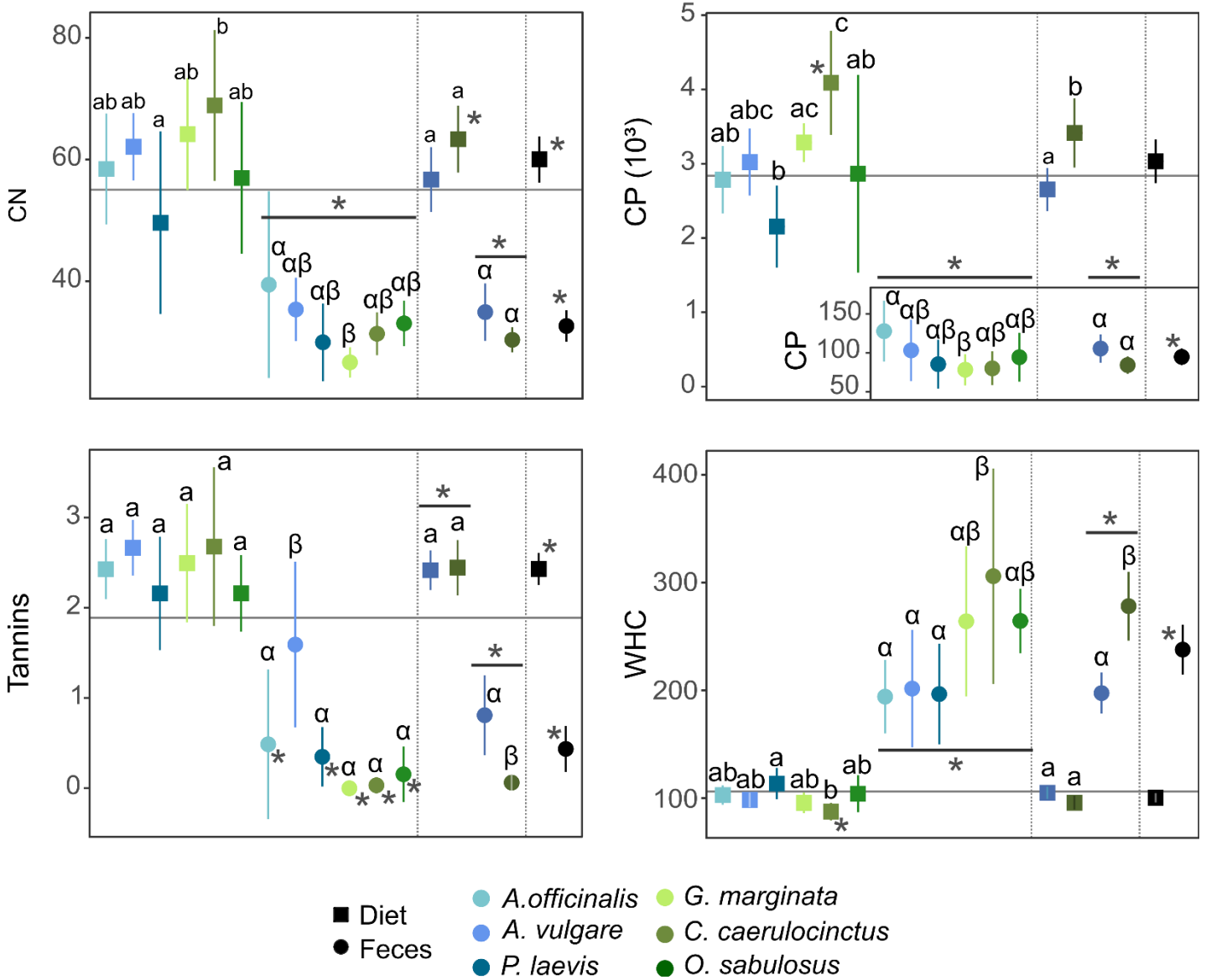
**Figure 1** – Mass specific consumption rate ( $\text{g}\cdot\text{g}^{-1}_{\text{faune}}\cdot\text{day}^{-1}$ ) of each macrodetrivore species. Differences between species mean value across all litter species are shown by uppercase letter, and differences between litter species mean value for each macrodetrivore species are shown with lowercase letter. Difference were tested by post-hoc Tukey test ( $\alpha=0.05$ ).



**Figure 2** – Saprophagous macroarthropod physiological trait relationships to species fresh body mass (g).  $C_i$  and  $C_m$  = individual and mass-specific consumption rate,  $H$  = diet diversity  $F_i$  and  $F_m$  = individual and mass-specific faeces production rate,  $A$  = assimilation rate. The grey line is the linear regression with 95% confidence interval when the relationships was significant, dashed otherwise.



**Figure 3** – Changes in C:N and C:P ratio, tannins content (%), and Water Holding Capacity (WHC) between available litter mix (light grey line), diet and faeces respectively. Smallcase and greek letter indicate significant differences between detritivore species on diet and faeces trait respectively after Tukey post-hoc test. Asterisks indicate significant difference from the available litter mix value.



# SUPPLEMENTARY INFORMATIONS

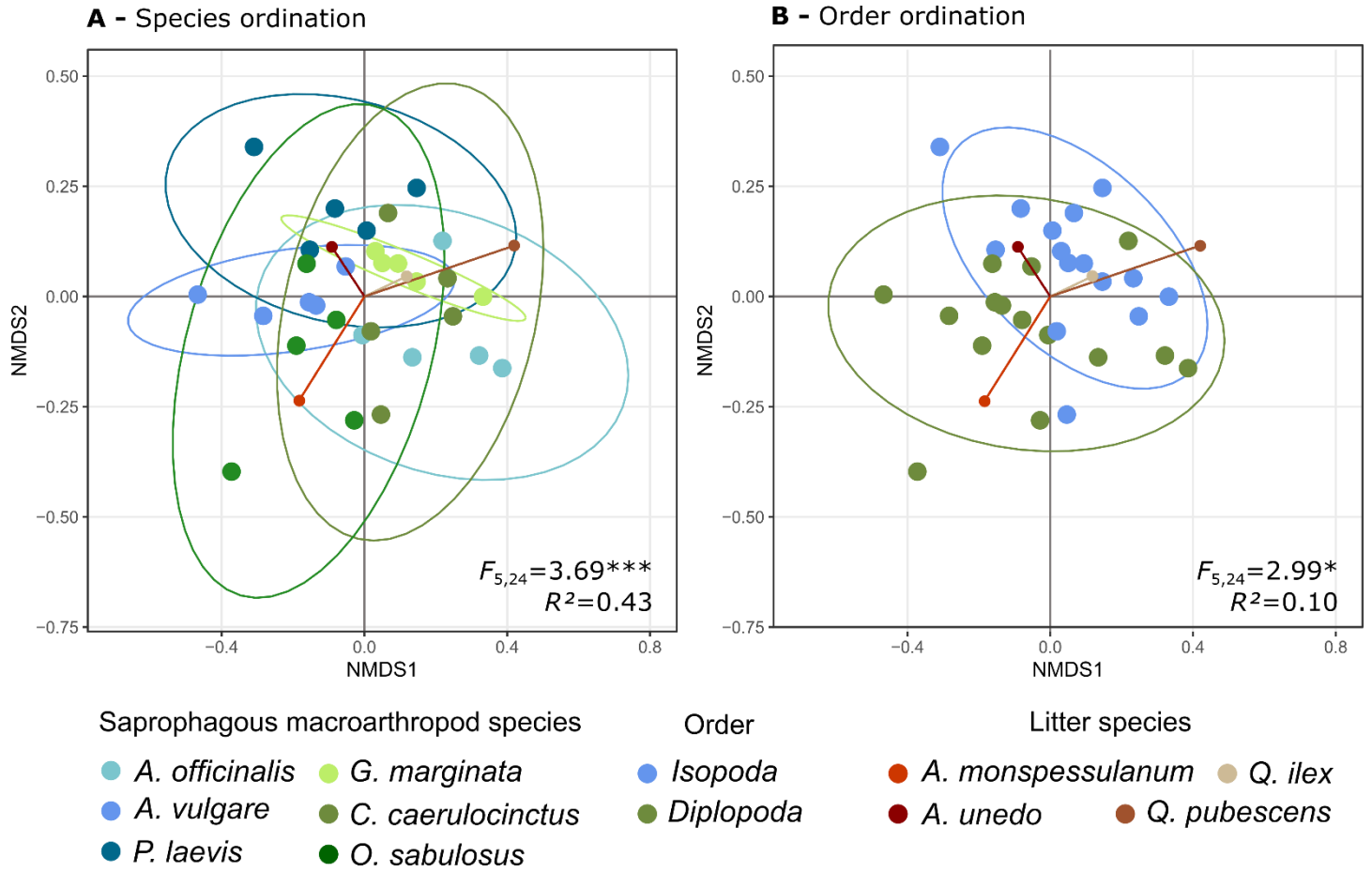
**Table S1** – Biological material sampling site information

	<b>Site of collection</b>	<b>Coordinates</b>	<b>Method of collection</b>
<b>Tree species</b>			
<i>Acer monspessulanum</i>	Mas d'Arnaud	43°60'N, 3°59'E	Litter traps
<i>Arbustus unedo</i>	Montarnaud	43°39'N, 3°40'E	Ground collection
<i>Quercus ilex</i>	Puechabon	43°44'N, 3°35'E	Litter traps
<i>Quercus pubescens</i>	CEFE	43°63'N, 3°86'E	Litter traps
<b>Detritivore species</b>			
<i>Armadillo officinalis</i>	ECOTRON	43°68'N, 3°88'E	Hand sorting
<i>Armadillidum vulgare</i>	Montarnaud	43°39'N, 3°40'E	Hand sorting
<i>Porcellio laevis</i>	CEFE	43°44'N, 3°35'E	Hand sorting
<i>Glomeris marginata</i>	Montarnaud	43°39'N, 3°40'E	Hand sorting
<i>Cylindroiulus caerulocinctus</i>	Montarnaud	43°39'N, 3°40'E	Hand sorting
<i>Ommatoiulus sabulosus</i>	Marseille	43°36'N, 3°42'E	Hand sorting

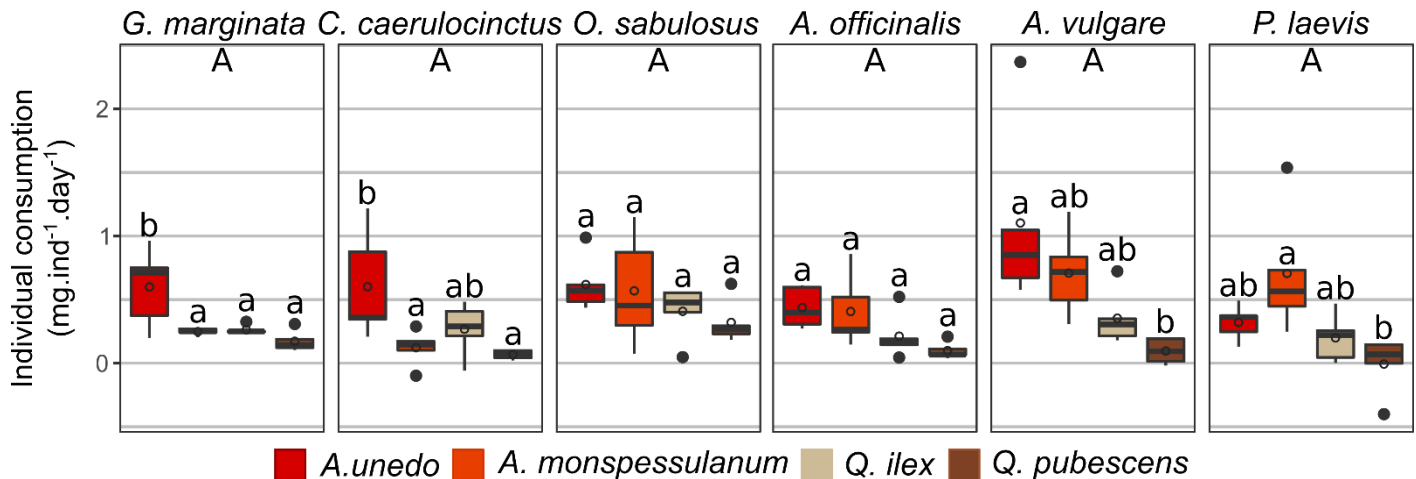




**Figure S2** – NMDS ordination of the animals diet composition. Ellipse show 95% confidence interval of **A** species and **B** order assignation. The bottom right corner display the  $F$  statistic, significance level (\*:  $pval < 0.05$ , \*\*\*:  $pval < 0.01$ ) and proportion of explained variance ( $R^2$ ) of independent PERMANOVA tests for species and order effect.



**Figure S4** – Individual consumption rate ( $g.ind^{-1}.day^{-1}$ ) by macrodetritivore species. Differences between species mean value across all litter species are shown by uppercase letter, and differences between litter species mean value for each macrodetritivore species are shown with lowercase letter. Difference were tested by post-hoc Tukey test.





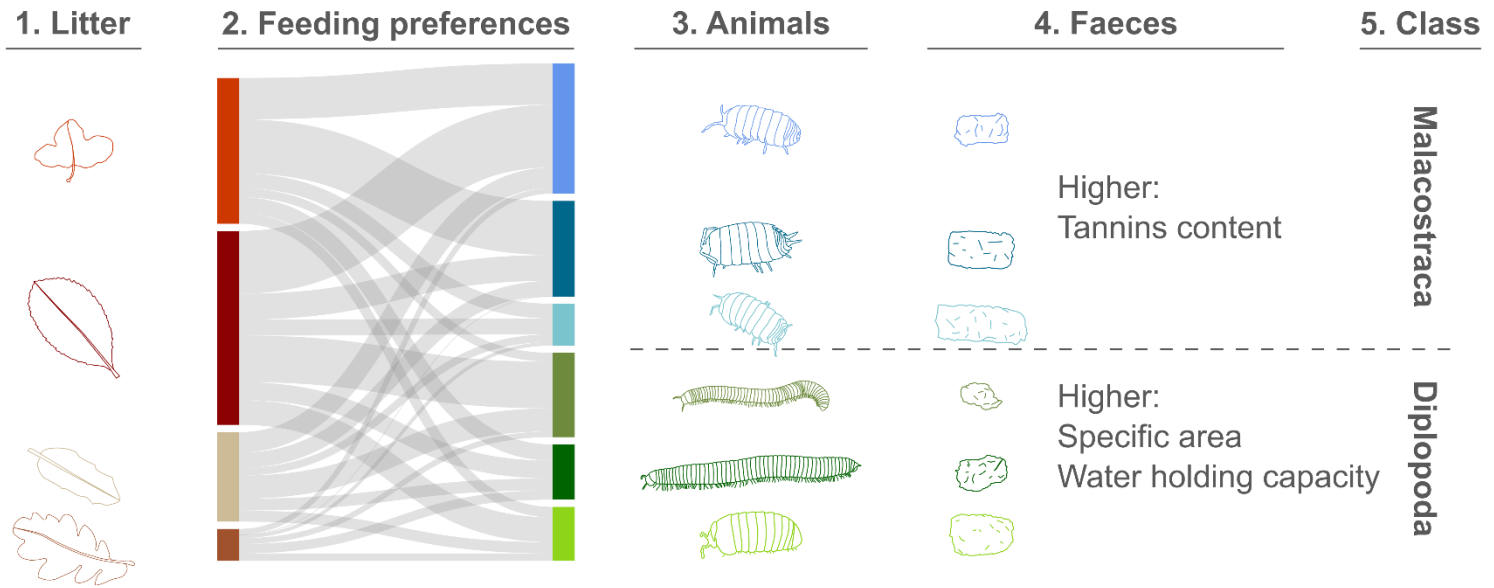
**Table S2** – Statistic table of linear models (species and order effect) and linear mixed models (body mass effects) on saprophagous macroarthropods physiological traits. The table displays the F statistic with degree of freedom (underscore), p value (\*:p<0.05, \*\*\*:p<0.001). Adjusted explained variance is given for linear models, while conditionnal (fixed + random effects) and marginal (random effects only) explained variance is given for mixed models.

Response variable	Species			Order			Body mass			
	$F_{5,24}$	$p$	$R^2_{adj}$	$F_{1,28}$	$p$	$R^2_{adj}$	$F_{1,27}$	$p$	$R^2_c$	$R^2_m$
Fresh body mass (g)	<b>57.1</b>	<b>&lt;0.001***</b>	<b>0.91</b>	1.4	0.25	0.05				
Ci (mg ind <sup>-1</sup> day <sup>-1</sup> )	<b>3.2</b>	<b>0.02*</b>	<b>0.36</b>	<0.1	0.88	0.0	1.5	0.23	0.37	0.09
C <sub>m</sub> (mg g <sub>fresh weight</sub> <sup>-1</sup> day <sup>-1</sup> )	<b>6.5</b>	<b>&lt;0.001***</b>	<b>0.53</b>	2.6	0.12	0.08	<b>4.5</b>	<b>0.04*</b>	<b>0.51</b>	<b>0.24</b>
H (Shannon index)	1.9	0.12	0.25	0.5	0.5	0.02	<b>6.0</b>	<b>0.02*</b>	<b>0.17</b>	<b>0.17</b>
Fi (mg ind <sup>-1</sup> day <sup>-1</sup> )	<b>3.8</b>	<b>0.01*</b>	<b>0.39</b>	0.2	0.67	0.01	2.1	0.16	0.51	0.13
Fm (mg g <sub>fresh weight</sub> <sup>-1</sup> day <sup>-1</sup> )	<b>12.0</b>	<b>&lt;0.001***</b>	<b>0.67</b>	0.3	0.57	0.01	3.0	0.09	0.61	0.18
A (%)	1.7	0.17	0.23	1.9	0.18	0.06	0.0	0.88	0.16	0.0

**Table S3** - Diet (ingested litter) and faeces characteristic by species and class. C: carbon, N: nitrogen, P: phosphorus, C:X: carbon to nutrient ratio, Ca: calcium content, T: tannins content, WHC: water holding capacity, FSA: faeces specific area. Mean ± sd are displayed with lowercase letter indicating significant differences after post-hoc Tukey comparison between class and species means separately.

	C %	N %	P %	C:N	C:P	Ca	T	WHC	FSA
<b>Litter</b>	<b>48 ± 0</b>	<b>0.65 ± 0</b>	<b>0.09 ± 0</b>	<b>95.6 ± 0.7</b>	<b>2942 ± 32</b>	<b>0.09 ± 0</b>	<b>1.9 ± 0</b>	<b>106.3 ± 0.4</b>	na
<b>Diet</b>	<b>45,8 ± 0,6</b>	<b>1 ± 0,2</b>	<b>0.09 ± 0.04</b>	<b>60 ± 10,2</b>	<b>3215 ± 809</b>	<b>0.09 ± 0.04</b>	<b>2.4 ± 0.5</b>	<b>100.3 ± 11.7</b>	na
<i>Malacostraca</i>	45,6 ± 0,4 <sup>a</sup>	1,1 ± 0,2 <sup>a</sup>	0.11 ± 0.03 <sup>a</sup>	56,7 ± 9,6 <sup>a</sup>	2834 ± 561 <sup>a</sup>	0.11 ± 0.03 <sup>a</sup>	2.4 ± 0.4 <sup>a</sup>	104.9 ± 10.3 <sup>a</sup>	na
<i>Diplopoda</i>	45,9 ± 0,7 <sup>a</sup>	0,9 ± 0,2 <sup>a</sup>	0.07 ± 0.04 <sup>b</sup>	63,3 ± 9,9 <sup>a</sup>	3595 ± 855 <sup>b</sup>	0.07 ± 0.04 <sup>b</sup>	2.4 ± 0.6 <sup>a</sup>	95.8 ± 11.5 <sup>b</sup>	na
<i>A. officinalis</i>	45,6 ± 0,4 <sup>a</sup>	1,1 ± 0,2 <sup>ab</sup>	0.1 ± 0.03 <sup>ab</sup>	58,4 ± 7,4 <sup>ab</sup>	2967 ± 374 <sup>ab</sup>	0.1 ± 0.03 <sup>ab</sup>	2.4 ± 0.3 <sup>a</sup>	102.9 ± 7.2 <sup>ab</sup>	na
<i>A. vulgare</i>	45,6 ± 0,2 <sup>a</sup>	1 ± 0,1 <sup>ab</sup>	0.09 ± 0.02 <sup>ab</sup>	62,1 ± 4,4 <sup>ab</sup>	3238 ± 379 <sup>abc</sup>	0.09 ± 0.02 <sup>ab</sup>	2.7 ± 0.2 <sup>a</sup>	98.3 ± 5.5 <sup>ab</sup>	na
<i>P. laevis</i>	45,6 ± 0,6 <sup>a</sup>	1,3 ± 0,3 <sup>a</sup>	0.14 ± 0.04 <sup>a</sup>	49,6 ± 12,1 <sup>a</sup>	2297 ± 479 <sup>b</sup>	0.14 ± 0.04 <sup>a</sup>	2.2 ± 0.5 <sup>a</sup>	113.5 ± 11.7 <sup>a</sup>	na
<i>G. marginata</i>	45,7 ± 0,2 <sup>a</sup>	0,9 ± 0,1 <sup>b</sup>	0.07 ± 0.01 <sup>b</sup>	64,2 ± 7,4 <sup>ab</sup>	3478 ± 288 <sup>ac</sup>	0.07 ± 0.01 <sup>b</sup>	2.5 ± 0.5 <sup>a</sup>	95.7 ± 7.8 <sup>ab</sup>	na
<i>C. caerulocinctus</i>	46,2 ± 1,1 <sup>a</sup>	0,8 ± 0,1 <sup>b</sup>	0.04 ± 0.01 <sup>b</sup>	68,9 ± 10 <sup>b</sup>	4297 ± 451 <sup>c</sup>	0.04 ± 0.01 <sup>b</sup>	2.7 ± 0.7 <sup>a</sup>	87.5 ± 6.5 <sup>a</sup>	na
<i>O. sabulosus</i>	45,7 ± 0,5 <sup>a</sup>	1,1 ± 0,2 <sup>ab</sup>	0.09 ± 0.05 <sup>ab</sup>	57 ± 10 <sup>ab</sup>	3010 ± 1101 <sup>-</sup>	0.09 ± 0.05 <sup>ab</sup>	2.2 ± 0.3 <sup>a</sup>	104.1 ± 13.8 <sup>ab</sup>	na
<b>Faeces</b>	<b>43 ± 2.4</b>	<b>1.36 ± 0.23</b>	<b>0.49 ± 0.13</b>	<b>32.6 ± 6.9</b>	<b>95 ± 29</b>	na	<b>0.4 ± 0.7</b>	<b>237.8 ± 62.2</b>	<b>3.81 ± 1.18</b>
<i>Malacostraca</i>	43.5 ± 3 <sup>a</sup>	1.3 ± 0.28 <sup>a</sup>	0.45 ± 0.14 <sup>a</sup>	34.9 ± 8.5 <sup>a</sup>	105 ± 33 <sup>a</sup>	na	0.8 ± 0.8 <sup>a</sup>	197.5 ± 34.4 <sup>a</sup>	4.63 ± 0.93 <sup>a</sup>
<i>Diplopoda</i>	42.5 ± 1.6 <sup>a</sup>	1.42 ± 0.17 <sup>a</sup>	0.53 ± 0.12 <sup>a</sup>	30.4 ± 3.7 <sup>a</sup>	84 ± 20 <sup>b</sup>	na	0.1 ± 0.2 <sup>b</sup>	278.2 ± 57.7 <sup>b</sup>	2.98 ± 0.75 <sup>b</sup>
<i>A. officinalis</i>	42.7 ± 4.5 <sup>a</sup>	1.16 ± 0.35 <sup>a</sup>	0.36 ± 0.15 <sup>a</sup>	39.4 ± 12.4 <sup>a</sup>	128 ± 32 <sup>a</sup>	na	0.5 ± 0.7 <sup>a</sup>	194.2 ± 27.6 <sup>a</sup>	5.59 ± 0.73 <sup>a</sup>
<i>A. vulgare</i>	44.5 ± 2.8 <sup>a</sup>	1.27 ± 0.16 <sup>a</sup>	0.46 ± 0.1 <sup>a</sup>	35.3 ± 4.2 <sup>ab</sup>	103 ± 32 <sup>ab</sup>	na	1.6 ± 0.7 <sup>b</sup>	201.7 ± 44 <sup>a</sup>	4.11 ± 0.74 <sup>b</sup>
<i>P. laevis</i>	43.3 ± 1.4 <sup>a</sup>	1.48 ± 0.25 <sup>a</sup>	0.54 ± 0.12 <sup>a</sup>	30 ± 5.1 <sup>ab</sup>	85 ± 25 <sup>ab</sup>	na	0.3 ± 0.3 <sup>a</sup>	196.6 ± 37.7 <sup>a</sup>	4.19 ± 0.43 <sup>b</sup>
<i>G. marginata</i>	41.7 ± 2.2 <sup>a</sup>	1.57 ± 0.13 <sup>a</sup>	0.55 ± 0.11 <sup>a</sup>	26.7 ± 2 <sup>b</sup>	78 ± 16 <sup>b</sup>	na	0 ± 0 <sup>a</sup>	264.1 ± 56.1 <sup>ab</sup>	3.01 ± 0.28 <sup>bc</sup>
<i>C. caerulocinctus</i>	42.4 ± 1.2 <sup>a</sup>	1.36 ± 0.16 <sup>a</sup>	0.55 ± 0.13 <sup>a</sup>	31.4 ± 2.8 <sup>ab</sup>	80 ± 17 <sup>ab</sup>	na	0 ± 0.1 <sup>a</sup>	306 ± 80.5 <sup>b</sup>	3.37 ± 1.09 <sup>bc</sup>
<i>O. sabulosus</i>	43.6 ± 0.8 <sup>a</sup>	1.33 ± 0.12 <sup>a</sup>	0.49 ± 0.13 <sup>a</sup>	33.1 ± 3 <sup>ab</sup>	94 ± 25 <sup>ab</sup>	na	0.2 ± 0.2 <sup>a</sup>	264.4 ± 24.1 <sup>ab</sup>	2.58 ± 0.55 <sup>c</sup>

**Figure S5 GRAPHICAL ABSTRACT** – Feeding preferences (mass-specific consumption rate) of six widespread saprophagous macroarthropods species for four mixed litter species of contrasted quality resulting in faeces of different physico-chemical properties.



- 1. Litter** species differ in their chemical, physical and morphological characteristic defining the available resource mean quality
- Animals **feeding preferences** for particular litter trait values change the actual ingested resource (diet) mean quality
- Animals** species differ in their feeding & physiological traits
- Faeces** production & characteristics depend on animal identity
- Class**-specific digestive track structure leads to differences in faeces characteristics
- Body mass** is a simple predictor of complex physiological traits

#### 6. Body mass

