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Title: **Shepherds' local knowledge and scientific data on the scavenging ecosystem service: Insights for conservation**

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Table S1. Species included in the questionnaires in each study area. Vertebrate scavenger species detected in the monitoring of the consumption of carcasses using camera traps and/or other scavenger species breeding in each study area were included.

Scientific name	**Common name**	**Cantabrian Mountains**	**Baetic Mountains**
Birds			
Aegypius monachus	Cinereous vulture	**Yes**	**Yes**
Gypaetus barbatus	Bearded vulture	No	**Yes**
Gyps fulvus	Griffon vulture	**Yes**	**Yes**
Neophron percnopterus	Egyptian vulture	**Yes**	**Yes**
Aquila chrysaetos	Golden eagle	**Yes**	**Yes**
Buteo buteo	Common buzzard	**Yes**	No
Milvus migrans	Black kite	No	**Yes**
Milvus milvus	Red kite	**Yes**	**Yes**
Corvus corax	Common raven	**Yes**	**Yes**
Corvus corone	Carrion crow	**Yes**	**Yes**
Garrulus glandarius	Eurasian jay	**Yes**	No
Pica pica	Common magpie	**Yes**	**Yes**
Mammals			
Ursus arctos	Brown bear	**Yes**	No
Canis lupus	Gray wolf	**Yes**	No
Vulpes vulpes	Red fox	**Yes**	**Yes**
Genetta genetta	Common genet	**Yes**	No
Martes foina[*]	Stone marten	**Yes**	**Yes**
Martes martes[*]	Pine marten	**Yes**	No
Meles meles	Eurasian badger	**Yes**	No
Sus scrofa	Wild boar	**Yes**	**Yes**

[*] In Cantabrian Mountains, we considered stone marten (*Martes foina*) and pine marten (*M. martes*) together as *Martes spp*. because specific identification was not possible from the pictures at night (n = 1 carcass).

Table S2. Overview of the variables and questions included in the questionnaires to investigate shepherds' indigenous and local knowledge (ILK).

Variable	Description
Species level	
Frequency of occurrence at carcasses ILK	For each species, average frequency of observation by shepherds of such species scavenging at carcasses in each study area, according to the following categories: 0 (never), 1 (less than half the times), 2 (half the times), 3 (more than half the times) and 4 (always). Question: how often do you see each species scavenging at livestock carcasses in your area?
Scavenging service ILK	For each species, percentage of shepherds that considered such species as a provider of the scavenging service (i.e., carcass consumption). Ln (x+1) transformation was applied to avoid heteroscedasticity. Questions: which species scavenge your livestock carcasses? Could you rank each species by its importance in the removal of your livestock carcasses?
Community level	
Detection time ILK	For each livestock carcass, average perception of the time elapsed (in hours) since the carcass became available until the arrival of the first scavenger. Question: how long do scavengers normally take to detect a carcass?
Consumption time ILK	For each livestock carcass, average perception of the time elapsed (in hours) since the carcass became available until it was completely consumed (i.e., only bones, skin and dehydrated meat left; Moleón et al. 2015). Question: how long do scavengers normally take to completely consume a carcass?

Table S3. Overview of the variables of scientific knowledge (SK).

Name of variable	Description
Species level	
Frequency of occurrence at carcasses SK	For each species, average frequency of occurrence of such species feeding on the carcasses within each study area. Variable obtained from camera trap monitoring of carcass consumption (Mateo-Tomás et al. 2015).
Biomass consumed SK	For each species, average percentage of biomass consumed by such species at all the carcasses in each study area. See Appendix S1 for further details. Variable obtained from camera trap monitoring of carcass consumption. Ln (x+1) transformation was applied to avoid heteroscedasticity.
Community level	
Detection time SK	For each experimental carcass, average time elapsed (in hours) since the carcass became available until the arrival of the first scavenger. Variable obtained from camera trap monitoring of carcass consumption.
Consumption time SK	For each experimental carcass, average time elapsed (in hours) since the carcass became available until it was completely consumed (i.e., only bones, skin and dehydrated meat left; Moleón et al. 2015). Variable obtained from camera trap monitoring of carcass consumption.

Table S4. Analysis of covariance testing the effects of the shepherds' age ('born' as covariate) on the relationships between scientific knowledge (i.e., 'frequency of occurrence at carcasses SK' and 'biomass consumed SK') and indigenous and local knowledge (i.e., 'frequency of occurrence at carcasses ILK' and 'scavenging service ILK') at the species level in each study area. Values statistically significant are indicated in bold. Description of the variables is provided in Table S2 and S3. The regression lines are provided in Figs. 4a–b.

Study area	**SK-ILK**	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
Cantabrian Mountains	Frequency of occurrence at carcasses SK - Frequency of occurrence at carcasses ILK	Frequency of occurrence at carcasses ILK	1	1.425	1.425	16.969	**< 0.001**
		Born	2	0.024	0.012	0.142	0.868
		Frequency of occurrence at carcasses ILK:Born	2	0.123	0.062	0.734	0.485
		Residuals	46	3.863	0.084		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.235	0.076	3.084	**0.003**
		Frequency of occurrence at carcasses ILK		0.225	0.111	2.022	**0.049**
		Born ≥1970		-0.102	0.113	-0.897	0.374
		Born 1960		-0.018	0.109	-0.162	0.872
		Frequency of occurrence at carcasses ILK:Born ≥1970		0.121	0.158	0.762	0.450
		Frequency of occurrence at carcasses ILK:Born 1960		-0.046	0.137	-0.334	0.740
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
	Biomass consumed SK - Scavenging service ILK	Scavenging service ILK	1	58.325	58.325	242.552	**< 0.0001**
		Born	2	0.092	0.046	0.191	0.827
		Scavenging service ILK:Born	2	0.502	0.251	1.044	0.360
		Residuals	46	11.061	0.240		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.223	0.145	1.537	0.131
		Scavenging service ILK		0.690	0.075	9.258	**< 0.0001**
		Born ≥1970		-0.036	0.202	-0.178	0.860
		Born 1960		0.063	0.206	0.303	0.763

		Scavenging service ILK:Born ≥1970		-0.033	0.101	-0.328	0.744
		Scavenging service ILK:Born 1960		-0.136	0.100	-1.358	0.181
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
Baetic Mountains	Frequency of occurrence at carcasses SK - Frequency of occurrence at carcasses ILK	Frequency of occurrence at carcasses ILK	1	1.712	1.712	24.201	**< 0.0001**
		Born	2	0.034	0.017	0.241	0.788
		Frequency of occurrence at carcasses ILK:Born	2	0.046	0.023	0.327	0.723
		Residuals	31	2.193	0.071		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.194	0.110	1.759	0.088
		Frequency of occurrence at carcasses ILK		0.109	0.049	2.200	**0.035**
		Born ≥1970		-0.139	0.153	-0.904	0.373
		Born 1960		-0.145	0.156	-0.931	0.359
		Frequency of occurrence at carcasses ILK:Born ≥1970		0.050	0.070	0.717	0.479
		Frequency of occurrence at carcasses ILK:Born 1960		0.048	0.070	0.681	0.501
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
	Biomass consumed SK - Scavenging service ILK	Scavenging service ILK	1	21.479	21.479	18.172	**< 0.001**
		Born	2	0.112	0.056	0.048	0.954
		Scavenging service ILK:Born	2	0.007	0.003	0.003	0.997
		Residuals	31	36.643	1.182		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.026	0.440	0.060	0.953
		Scavenging service ILK		0.427	0.167	2.562	**0.016**
		Born ≥1970		-0.100	0.614	-0.163	0.872
		Born 1960		-0.090	0.612	-0.147	0.884
		Scavenging service ILK:Born ≥1970		-0.018	0.238	-0.075	0.941
		Scavenging service ILK:Born 1960		-0.008	0.241	-0.032	0.975

Table S5. Analysis of covariance testing the effects of the experience as a shepherd ('experience' as covariate) on the relationships between scientific knowledge (i.e., 'frequency of occurrence at carcasses SK' and 'biomass consumed SK') and indigenous and local knowledge (i.e., 'frequency of occurrence at carcasses ILK' and 'scavenging service ILK') at the species level in each study area. Values statistically significant are indicated in bold. Description of the variables is provided in Table S2 and S3. The regression lines are provided in Figs. 4c–d.

Study area	**SK-ILK**	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
Cantabrian Mountains	Frequency of occurrence at carcasses SK - Frequency of occurrence at carcasses ILK	Frequency of occurrence at carcasses ILK	1	1.477	1.477	17.235	**< 0.001**
		Experience	2	0.024	0.012	0.139	0.871
		Frequency of occurrence at carcasses ILK:Experience	2	0.042	0.021	0.248	0.782
		Residuals	45	3.855	0.086		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.201	0.081	2.479	**0.017**
		Frequency of occurrence at carcasses ILK		0.307	0.130	2.352	**0.023**
		Experience 21-40		-0.033	0.114	-0.288	0.775
		Experience ≥41		0.032	0.114	0.278	0.782
		Frequency of occurrence at carcasses ILK:Experience 21-40		-0.053	0.159	-0.334	0.740
		Frequency of occurrence at carcasses ILK:Experience ≥41		-0.109	0.160	-0.683	0.498
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
	Biomass consumed SK - Scavenging service ILK	Scavenging service ILK	1	60.495	60.495	305.443	**< 0.0001**
		Experience	2	0.014	0.007	0.036	0.964
		Scavenging service ILK:Experience	2	0.149	0.074	0.376	0.689
		Residuals	46	9.111	0.198		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.189	0.133	1.425	0.161
		Scavenging service ILK		0.664	0.064	10.419	**< 0.0001**
		Experience 21-40		0.062	0.184	0.337	0.737
		Experience ≥41		0.020	0.187	0.106	0.916

		Scavenging service ILK:Experience 21-40		-0.063	0.089	-0.707	0.483
		Scavenging service ILK:Experience ≥41		0.008	0.092	0.084	0.934
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
Baetic Mountains	Frequency of occurrence at carcasses SK - Frequency of occurrence at carcasses ILK	Frequency of occurrence at carcasses ILK	1	1.971	1.971	30.154	**< 0.0001**
		Experience	2	0.022	0.011	0.169	0.845
		Frequency of occurrence at carcasses ILK:Experience	2	0.001	0.001	0.009	0.992
		Residuals	32	2.092	0.065		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.088	0.109	0.806	0.426
		Frequency of occurrence at carcasses ILK		0.150	0.049	3.037	**0.005**
		Experience 21-40		-0.011	0.147	-0.074	0.941
		Experience ≥41		-0.053	0.155	-0.342	0.735
		Frequency of occurrence at carcasses ILK:Experience 21-40		0.008	0.069	0.123	0.903
		Frequency of occurrence at carcasses ILK:Experience ≥41		0.002	0.068	0.028	0.978
	SK-ILK	**Analysis of covariance table**	**DF**	**Sum**	**Sq mean**	**F value**	**Pr (>F)**
	Biomass consumed SK- Scavenging service ILK	Scavenging service ILK	1	18.726	18.726	15.067	**< 0.001**
		Experience	2	0.068	0.034	0.027	0.973
		Scavenging service ILK:Experience	2	0.145	0.073	0.059	0.943
		Residuals	32	39.772	1.243		
		Estimated coefficients		**Estimate**	**SE**	**t value**	**Pr (>|t|)**
		Intercept		0.067	0.448	0.149	0.883
		Scavenging service ILK		0.357	0.172	2.081	**0.046**
		Experience 21-40		-0.124	0.633	-0.196	0.846
		Experience ≥41		-0.185	0.631	-0.293	0.772
		Scavenging service ILK:Experience 21-40		0.012	0.239	0.052	0.959
		Scavenging service ILK:Experience ≥41		0.079	0.248	0.319	0.752

Table S6. U values and p value of Mann-Whitney U tests ($\alpha = 0.05$) of the differences between scientific knowledge (SK) and indigenous and local knowledge (ILK) about detection and consumption times of livestock carcasses by scavengers depending on shepherds' age ('born') and experience ('experience') in each study area. Significant differences between SK–ILK within the same study area are indicated in bold. Description of the variables is provided in Table S2 and S3. Mean and SD of detection and consumption times are provided in Figs. 3c–f.

		Variable SK – Variable ILK			
		Detection time SK – Detection time ILK		*Consumption time SK – Consumption time ILK*	
Study area	**Born**	*U*	*p value*	*U*	*p value*
Cantabrian Mountains	≤1950	15.0	0.498	33.0	**<0.001**
	1960	7.0	0.149	21.0	**0.003**
	≥1970	23.0	0.599	22.0	**< 0.001**
Baetic Mountains	≤1950	9.5	**0.011**	34.0	0.432
	1960	207.0	0.666	30.0	**< 0.0001**
	≥1970	175.0	0.204	24.0	**< 0.001**
	Experience				
Cantabrian Mountains	≤20	20.0	0.650	24.0	**< 0.001**
	21-40	10.0	0.164	28.0	**< 0.0001**
	≥41	15.0	0.498	24.0	**0.005**
Baetic Mountains	≤20	86.0	0.600	34.0	0.063
	21-40	177.0	0.390	19.0	**< 0.0001**
	≥41	128.5	0.102	35.0	**< 0.0001**

Appendix S1. Calculation of the biomass consumed (%) by each vertebrate scavenger species in each study area (see Mateo-Tomás et al. 2017 for further details).

First, for each study area (i.e., Cantabrian Mountains and Baetic Mountains), we estimated the carrion consumed by each vertebrate species scavenging at a carcass as:

$$Carrion\ consumed_i = \sum_{j=1}^{days} n_{ij} * DFI_i \quad \text{eq. (1)}$$

where n_{ij} is the abundance of species i recorded scavenging at a carcass (see above) on day j. This value was multiplied by the daily food intake of the species i (i.e., DFI_i) as resulting from the following equation (Crocker et al. 2002):

$$Daily\ Food\ Intake\ (DFI) = \frac{Daily\ Energy\ Expenditure\ (kJ)}{Food\ Energy\ \left(\frac{kJ}{g}\right) * (1 - Moisture) * Assimilation\ Efficiency} \quad \text{eq. (2)}$$

Daily Energy Expenditure has a strong relationship with body weight:

$$Log\ (Daily\ Energy\ Expenditure) = Log\ a\ +\ b\ *\ (log\ Body\ weight) \quad \text{eq. (3)}$$

Log a and *b* are parameters separately obtained from Hudson et al. (2013). Mean body weights for the recorded scavengers were obtained from official databases (i.e., PanTHERIA, HBW Alive; Jones et al. 2009; Del Hoyo et al. 2015). Energy and moisture content for mammal carrion were 22.6 kJ/g and 68.8% respectively (Crocker et al. 2002). Here, we assumed that each individual scavenger arriving at a carcass consumed the daily food intake.

Second, we estimated the percentage of biomass consumed per species i at each carcass c as:

$$Biomass\ consumed_i(\%) = \frac{Carrion\ consumed_{ci} * 100}{\sum_{i=1}^{N}(Carrion\ consumed_{ci})} \quad \text{eq. (4)}$$

Finally, we calculated the average biomass consumed (%) by each species at all the carcasses within each study area (i.e., the variable ‘biomass consumed SK’; see Table S3).

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