Appendix A – Supporting Information

Insectivore diet and abundance condition the specific contribution

of birds to ecosystem services and disservices in apple orchards

Table S1. Trait values of bird species captured in three study apple orchards of Asturias (northern Spain). RAB = relative abundance, the proportion of individuals recorded across orchards and censuses over the year (N = 825); INSEC = insectivory degree; WEIGHT = weight (gr); GAPE = gape width (mm); TARSUS = tarsus length (mm); KIPP = Kipp's index (Kipp's distance divided by wing length); BEAK = beak length (mm); TAIL = tail length (mm).

Species	Species Acronym	RAB	INSEC	WEIGHT	GAPE	TARSUS	KIPP	BEAK	TAIL
Aegithalos caudatus	AEG CAU	0.018	0.600	7.19	7.50	17.27	14.45	7.60	87.80
Carduelis carduelis	CAR CAR	0.031	0.100	13.49	7.64	14.54	16.48	15.40	48.60
Certhia brachydactyla	CER BRA	0.011	0.700	8.68	7.41	15.90	15.27	18.70	57.10
Chloris chloris	CHL CHL	0.013	0.100	24.67	11.29	18.05	18.76	14.40	55.70
Cyanistes caeruleus	CYA CAE	0.067	0.500	10.34	6.69	16.82	15.13	9.70	51.40
Dendrocopos major	DEN MAJ	0.013	0.500	68.13	15.71	23.48	32.00	27.90	88.00
Erithacus rubecula	ERI RUB	0.157	0.400	16.54	10.65	25.65	17.85	14.00	56.90
Ficedula hypoleuca	FIC HYP	0.010	1.000	13.40	10.62	17.30	18.75	12.80	52.10
Fringilla coelebs	FRI COE	0.039	0.600	20.97	9.56	18.23	18.09	14.70	65.90
Lanius collurio	LAN COL	0.004	0.600	26.59	14.18	23.08	20.53	18.70	75.90
Muscicapa striata	MUS STR	0.002	0.800	15.70	11.80	15.70	19.63	16.20	61.20
Nannus troglodytes	NAN TRO	0.062	0.600	8.64	7.95	17.31	11.80	13.80	30.50
Oriolus oriolus	ORI ORI	0.007	0.300	70.27	16.96	22.37	58.80	28.50	82.90
Parus major	PAR MAJ	0.067	0.400	16.68	8.72	19.81	17.46	11.30	61.20
Periparus ater	PER ATE	0.002	0.400	8.11	6.49	16.83	13.93	10.70	46.40
Phylloscopus collybita	PHY COL	0.006	0.800	7.11	7.02	19.74	13.44	11.60	48.50
Phylloscopus trochilus	PHY TRO	0.001	0.800	8.57	7.40	19.91	16.00	12.80	52.30
Picus sharpei	PIC SHA	0.003	0.900	179.50	15.84	30.44	43.42	45.00	103.00
Pyrrhula pyrrhula	PYR PYR	0.009	0.100	21.27	12.26	16.83	18.03	13.10	68.30
Regulus ignicapilla	REG IGN	0.019	1.000	5.04	6.81	17.17	11.88	10.90	39.40
Serinus serinus	SER SER	0.019	0.100	11.10	7.84	14.12	15.08	9.20	46.40
Sylvia atricapilla	SYL ATR	0.136	0.500	16.82	10.24	20.57	16.61	15.20	62.20
Sylvia borin	SYL BOR	0.001	0.500	17.38	10.47	20.34	18.50	15.10	57.90
Turdus iliacus	TUR ILI	0.055	0.400	60.45	13.59	28.60	28.33	22.70	78.30
Turdus merula	TUR MER	0.104	0.500	84.46	15.74	33.76	30.30	28.50	106.30
Turdus philomelos	TUR PHI	0.052	0.400	69.03	15.39	32.82	26.92	23.10	81.70

Table S2. Confidence set of the linear models and the generalised linear models fitted for each parameter. logLik = logarithmic likelihood; AICc = corrected Akaike Information Criterion; ΔAICc = AICc difference with respect to the AICc of the optimal model; df = degrees of freedom; Weight = Akaike weight. The models are ranked by AICc.

Parameter	Model	logLik	AICc	ΔAICc	df	Weight
Trophic Position	Insectivory degree * PCoA axis 1	17.221	-21.442	0.000	5	0.360
	Insectivory degree	13.666	-20.240	1.202	3	0.197
	Insectivory degree + PCoA axis 1	14.519	-19.134	2.309	4	0.114
	Insectivory degree * PCoA axis 1 + PCoA axis 2	17.274	-18.128	3.315	6	0.069
	Insectivory degree + PCoA axis 2	13.713	-17.520	3.922	4	0.051
	Insectivory degree * PCoA axis 2	15.216	-17.431	4.011	5	0.048
	Insectivory degree + PCoA axis 1 + PCoA axis 2	14.571	-16.143	5.300	5	0.025
	Insectivory degree * PCoA axis 2 + PCoA axis 1	15.951	-15.481	5.962	6	0.018
	PCoA axis 1	11.112	-15.133	6.309	3	0.015
	PCoA axis 2	10.553	-14.015	7.428	3	0.009
	Insectivory degree + PCoA axis 1 * PCoA axis 2	14.652	-12.882	8.560	6	0.005
	PCoA axis 1 + PCoA axis 2	11.112	-12.319	9.123	4	0.004
	PCoA axis 1 * PCoA axis 2	11.451	-9.903	11.539	5	0.001
Agronomic Quality	Trophic Position	7.097	-7.103	0.000	3	0.502
	Trophic Position + Relative Abundance	8.134	-6.364	0.739	4	0.347
	Trophic Position * Relative Abundance	8.289	-3.578	3.525	5	0.086
	Relative Abundance	3.655	-0.220	6.883	3	0.016
Proportion of apple pest in the diet	Trophic Position * Relative Abundance	-129.462	268.829	0.000	4	1.000
	Trophic Position	-140.550	285.622	16.794	2	0.000
	Trophic Position + Relative Abundance	-140.425	287.941	19.112	3	0.000
	Relative Abundance	-145.768	296.058	27.229	2	0.000

Table S3. Indexes values of bird species in three study apple orchards of Asturias (N Spain). wPOO = weighted percentage of occurrence of agronomic and ecological prey categories (ap = apple pests; ne = natural enemies; pt = phytophagous; pr = predators); AQ = agronomic quality; TP = trophic position; PP = apple pest proportion in the diet; QNT = quantity (abundance * insectivory degree); PC = species potential contribution (AQ * QNT).

Species Acronym	wPOOap	wPOOne	wPOOpt	wPOOpr	TP	AQ	PP	QNT	PC
AEG CAU	0.085	0.266	0.412	0.330	1.445	0.321	0.1864	9.60	3.08
CAR CAR	0.014	0.017	0.369	0.081	1.181	0.857	0.0339	2.80	2.40
CER BRA	0.063	0.111	0.374	0.315	1.458	0.565	0.1356	7.00	3.95
CHL CHL	0.019	0.081	0.283	0.155	1.353	0.236	0.0847	1.20	0.28
CYA CAE	0.090	0.251	0.461	0.392	1.459	0.358	0.2542	30.50	10.91
DEN MAJ	0.100	0.150	0.250	0.300	1.545	0.667	0.0339	6.00	4.00
ERI RUB	0.033	0.095	0.304	0.200	1.397	0.343	0.2712	57.20	19.65
FIC HYP	0.020	0.088	0.324	0.306	1.485	0.229	0.0678	9.00	2.06
FRI COE	0.021	0.087	0.372	0.192	1.340	0.239	0.1186	21.00	5.01
LAN COL	0.027	0.110	0.377	0.235	1.384	0.250	0.0339	2.40	0.60
MUS STR	0.044	0.191	0.338	0.305	1.475	0.232	0.0339	1.60	0.37
NAN TRO	0.016	0.125	0.333	0.284	1.461	0.125	0.1186	33.60	4.21
ORI ORI	0.135	0.094	0.586	0.232	1.283	1.441	0.0339	1.80	2.59
PAR MAJ	0.077	0.195	0.465	0.349	1.429	0.394	0.5254	24.40	9.62
PER ATE	0.060	0.257	0.448	0.347	1.436	0.235	0.0508	0.80	0.19
PHY COL	0.051	0.093	0.378	0.254	1.402	0.545	0.1525	4.00	2.18
PHY TRO	0.088	0.096	0.352	0.434	1.552	0.917	0.1356	0.80	0.73
PIC SHA	0.000	0.021	0.000	0.021	2.000	0.000	0.0000	2.70	0.00
PYR PYR	0.000	0.466	0.173	0.548	1.760	0.000	0.0000	0.80	0.00
REG IGN	0.038	0.279	0.228	0.414	1.646	0.136	0.1017	17.00	2.31
SER SER	0.025	0.044	0.379	0.130	1.255	0.584	0.1695	1.70	0.99
SYL ATR	0.028	0.115	0.318	0.252	1.442	0.244	0.4746	62.00	15.10
SYL BOR	0.014	0.184	0.214	0.310	1.591	0.078	0.0339	0.50	0.04
TUR ILI	0.000	0.072	0.211	0.105	1.333	0.000	0.0000	20.00	0.00
TUR MER	0.017	0.067	0.320	0.160	1.334	0.257	0.2034	47.50	12.22
TUR PHI	0.022	0.035	0.189	0.130	1.408	0.623	0.1356	18.80	11.72

Table S4. Results of the linear model evaluating the effects of quality (agronomic quality) and quantity (abundance weighted by degree of insectivory) components on the potential contribution of bird species to the pest control service. The percentage of the variance explained by each component individually is also shown. Significant effects are highlighted in bold.

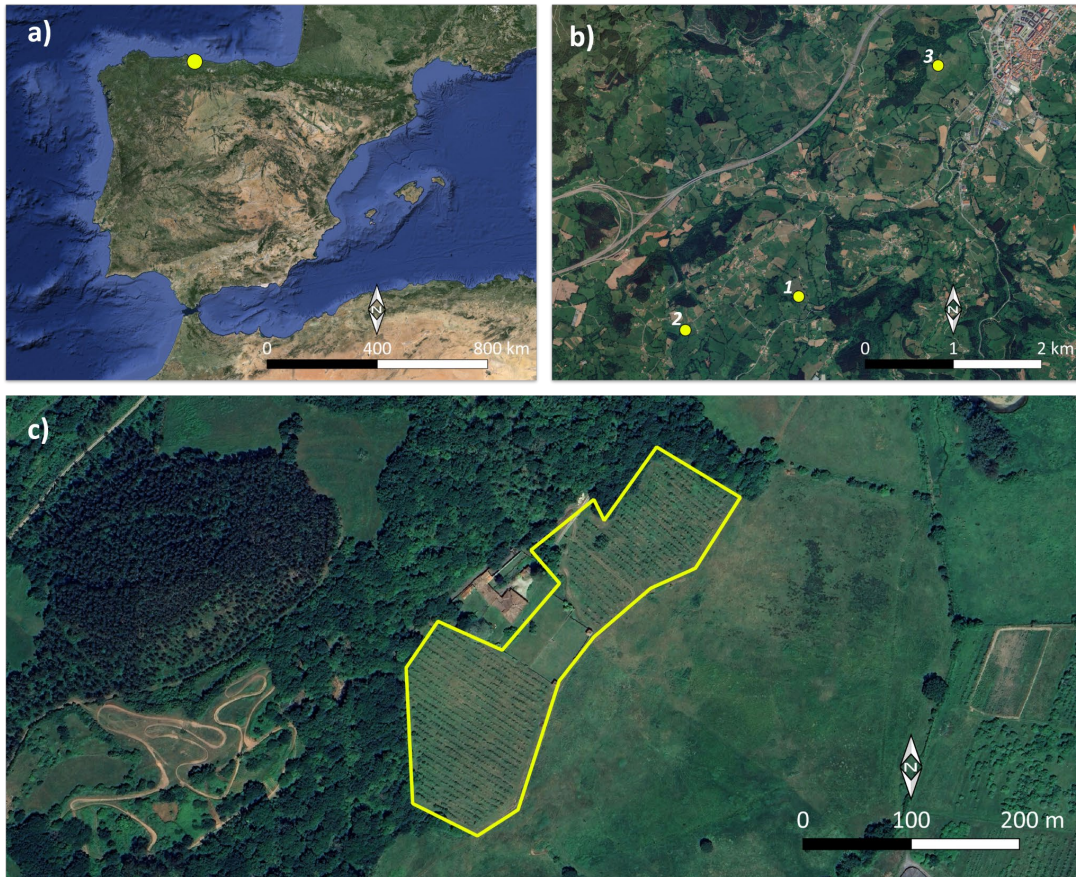|	Estimate	SE	t	p	R^2
Potential contribution of bird species to the pest control service *Gaussian (identity)*					
(Intercept)	4.393	0.432	10.180	< 0.001	
Quantity	**5.060**	**0.451**	**11.227**	**< 0.001**	0.846
Quality	**1.354**	**0.451**	**3.005**	**0.006**	
Variance explained by each component					
Quantity	0.815				
Quality	0.031				

Figure S1. (a) Location of the study sites in northern Spain. (b) View of study sites (1: 43º 27' 22'' N, 5º27'69'' W, 97 m asl; 2: 43º 27' 10'' N, 5º 28' 58'' W, 85 m asl; and 3: 43º 28' 44'' N, 5º 26' 54'' W, 25 m asl) in the region, highlighting the variegated landscape composed of a fine-grain mosaic with anthropogenic patches (pasture meadows, timber plantations, apple plantations, crops and orchards, urban settlements) and seminatural-woody habitats (like hedgerows and native forest patches). (c) Aerial view of site number 3.
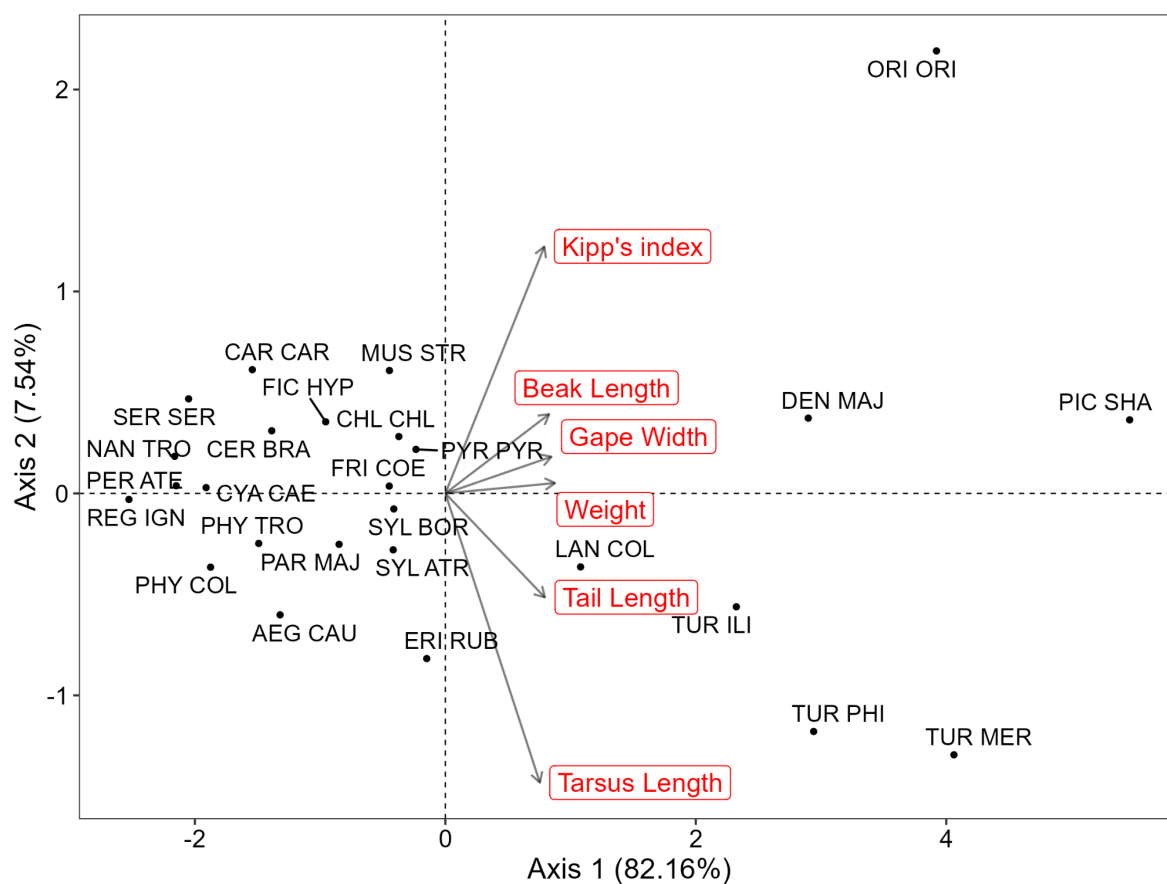
Figure S2. Morphological space of insectivorous birds (n = 26 species) in apple orchards, obtained from Principal Coordinates Analysis on species traits. Dots represent individual species, which are also indicated by their acronyms (for complete names see Table S1). Arrows indicate the correlation of space axes with the six morphological traits selected (in red).