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Supplementary material

Appendix 1

Table A1. Detected lineages of the parasite with the numbers of positive and the number of samples tested for each site.

LINEAGE NAME	GENBANK_NR	ParasiteGenus	Country	Country Region	Site Name	POSITIVE FOUND	NUMBER TESTED
ANLAT10	FJ839445	Leucocytozoon	Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	1	45
DELURB1	EU154343	Haemoproteus hirundinis	Italy	Piemonte	Cameri (PIEM_PORC-ZABO)	1	17
GRW02	AF254962	Plasmodium ashfordi	Italy	Piemonte	Fara Novarese (PIEM_RINALDI)	1	11
			Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	2	45
			Italy	Lombardia	Peschiera Borromeo (LOMB_Neri)	2	22
			Italy	Lombardia	Spino d'Adda (LOMB_FORN)	1	23
			Italy	Piemonte	Cameri (PIEM_PORC-ZABO)	1	17
GRW09	DQ060773	Plasmodium	Italy	Lombardia	Bertonico (LOMB_PIVA)	1	20
			Italy	Piemonte	Fara Novarese (PIEM_RINALDI)	2	11
			Italy	Piemonte	Momo (PIEM_CARD)	1	36
			Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	4	45
			Italy	Lombardia	Spino d'Adda (LOMB_FORN)	1	23
HIRUS01	DQ368350	Haemoproteus	Italy	Piemonte	Momo (PIEM_CARD)	1	36
HIRUS04	KP696487	Haemoproteus	Italy	Lombardia	Spino d'Adda (LOMB_FORN)	1	23
HIRUS06	KP696489	Plasmodium	Italy	Piemonte	Momo (PIEM_CARD)	2	36
			Italy	Lombardia	Bertonico (LOMB_PIVA)	1	20
HIRUS08	KP696491	Leucocytozoon	Italy	Piemonte	Cameri (PIEM_PORC-ZABO)	1	17
			Italy	Piemonte	Momo (PIEM_CARD)	1	36
			Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	1	45
HIRUS09	KP696492	Leucocytozoon	Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	1	45
HIRUS11	KP696494	Leucocytozoon	Italy	Lombardia	Spino d'Adda (LOMB_FORN)	1	23
SYBOR21	EF032871	Plasmodium	Italy	Lombardia	Bertonico (LOMB_PIVA)	1	20
			Italy	Piemonte	Momo (PIEM_CARD)	4	36
			Italy	Piemonte	Cameri (PIEM_PORC-ZABO)	1	17
			Italy	Piemonte	Oleggio (PIEM_BOLA-CROLA-NUOVA)	1	45
			Italy	Lombardia	Peschiera Borromeo (LOMB_Neri)	2	22
			Italy	Lombardia	San Zenone al Lambro (LOMB_Bianca)	1	22
SYBOR28	not sub	Leucocytozoon	Italy	Piemonte	Momo (PIEM_CARD)	1	36

Appendix 2

In a binomial linear mixed model with colony as a random effect, infection by *Leucocytozoon* was not predicted by sex ($F_{1,206} = 0.11$, $P = 0.736$, $r = 0$) or age ($F_{1,206} = 0.01$, $P = 0.917$, $r = 0$). As expected, the random effect of colony did not significantly contribute to the fit of the model (likelihood ratio test with Laplace approximation; $\chi^2 = 0.00$, $P > 0.99$).

Due to the very low number of individuals infected by *Leucocytozoon*, we preferred to not perform any analyses restricted to yearlings or on either sex separately.

Sampling occurred on average on May 10th (SD 14.1 days) and on average 2 days after laying of the first egg (SD 1.7 days). In a second analysis restricted to the individuals for which we had information on breeding date (see Table A1 for sample sizes) and where we included the effect of sex and age, we found no significant effect of breeding stage at blood sampling (difference between sampling and breeding date: $F_{1,173} = 0.21$, $P = 0.647$) or Julian date at blood sampling ($F_{1,173} = 0.45$, $P = 0.503$) on infection. In addition, inclusion of the second-order polynomial term of breeding stage to account for any non-linear effect of breeding stage on apparent infection status did not significantly improve the fit of the model (details not shown). These results imply that the probability that infection was detected did not change during the breeding season nor according to breeding stage.

Infection, breeding performance and annual survival

In linear mixed models, there were no significant effects of the interactions among infection status by *Leucocytozoon*, sex and age on both breeding date and seasonal number of eggs (Table A1). The main effect of infection did not predict neither breeding date nor seasonal number of eggs (Table A1). A binomial GLMM of annual survival with colony and pair identity as random effects did not show any significant effect of the interactions among

infection status, or sex (Table A2). A simplified model showed no main effects of infection by *Leucocytozoon*, age or sex on annual survival (Table A2).

Infection and morphological traits

Infection by *Leucocytozoon* did not predict tail length, plumage coloration and growth bar width either per se or in combination with age or sex (Table A3).

Finally, there was no main effect of infection on body condition index ($F_{1,197} = 0.02$, $P = 0.902$, $r = 0$) while controlling for the effect of sex and age in a linear mixed model with pair identity and colony as random effects.

Table A2. Linear mixed models of breeding date and seasonal breeding output (total number of eggs) in relation to infection by *Leucocytozoon*, age (yearling coded as 0; older coded as 1) and sex. In the models, we included the random effect of colony and identity of the breeding pair. The effects of the interaction between *Leucocytozoon* infection and age or, respectively, sex are reported but are excluded from the final models because they were non-significant. Age was included as a covariate. In the model of breeding date we assumed a Gaussian error distribution while in the model of number of eggs we assumed a Poisson data distribution. The effect of colony and pair identity was tested by likelihood ratio tests comparing the model including both terms with that excluding the focal term. Sample sizes are given in parentheses for males and females.

	χ^2	F	df	P	r
Breeding date (98; 90)					
Final model					
Colony	0.00		1	>0.99	
Pair identity*					
Infection by <i>Leucocytozoon</i>		0.03	1,184	0.858	0
Age		99.70	1,184	<0.001 ^a	0.590
Sex		2.58	1,184	0.110	0.118
Excluded terms					
Infection by <i>Leucocytozoon</i> × Age		1.35	1,181	0.246	
Infection by <i>Leucocytozoon</i> × Sex		0.39	1,181	0.534	
Age × Sex		1.22	1,181	0.272	
Seasonal clutch size (98; 93)					
Final model					
Colony	28.97		1	<0.001	
Pair identity*					
Infection by <i>Leucocytozoon</i>		1.09	1,184	0.299 ^b	0.077
Age		24.19	1,187	<0.001 ^c	0.332
Sex		0.05	1,187	0.823	0
Excluded terms					
Infection by <i>Leucocytozoon</i> × Age		0	1,184	0.965	
Infection by <i>Leucocytozoon</i> × Sex		0.28	1,184	0.599	
Age × Sex		1.11	1,184	0.294	

* The effect of pair identity was excluded from the model because its inclusion caused failure of model convergence

Table A3. Binomial linear mixed model of annual survival in relation to infection by *Leucocytozoon*, age (yearling vs older), sex and the pairwise interactions. Colony and pair identity were included as random effects in the model and their effect was tested by likelihood ratio test with Laplace approximation. The non-significant interaction effects were excluded from the final model. Sample sizes are 98 for males and 111 for females.

	χ^2	F	df	P	r
Annual survival					
Final model					
Colony	0.53		1	0.467	
Pair identity	2.04		1	0.153	
Infection by <i>Leucocytozoon</i>		0.33	1,205	0.567 ^a	0.045
Age		0.41	1,165	0.523	0.055
Sex		2.19	1,205	0.141	0.110
Excluded terms					
Infection by <i>Leucocytozoon</i> × Age		0.3	1,202	0.584	
Infection by <i>Leucocytozoon</i> × Sex		0.42	1,202	0.518	
Age × Sex		1.23	1,202	0.268	

Table A4. Linear mixed models of tail length, plumage hue in the ‘visible’ spectrum (θ) and growth bar width in relation to infection by *Leucocytozoon*, age (yearling coded as 0; older coded as 1) and sex. In the models we included the random effect of colony and identity of the breeding pair. The effects of the two-way interactions are included in the final model when significant, otherwise they are excluded. The effect of colony and pair identity was tested by likelihood ratio tests (see Statistical analyses). Sample sizes are given in parentheses for males and females.

	χ^2	F	df	P	r
Tail length (98; 110)					
Final model					
Colony	1.1		1	0.294	
Pair identity	0.00		1	>0.99	
Infection by <i>Leucocytozoon</i>		0.10	1,204	0.752	0
Age		9.89	1,155	0.002	0.241
Sex		265.58	1,125	<0.001	0.748
Excluded terms					
Infection by <i>Leucocytozoon</i> × Age		0.17	1,201	0.682	
Infection by <i>Leucocytozoon</i> × Sex		0.21	1,201	0.648	
Age × Sex		0.12	1,150	0.726	
Plumage coloration (98; 106)					
Final model					
Colony	5.6		1	0.018	
Pair identity	4.5		1	0.034	
Infection by <i>Leucocytozoon</i>		0.19	1,200	0.667	0.032
Age		2.31	1,194	0.13	0.105
Sex		19.4	1,193	<0.001	0.300
Excluded terms					
Infection by <i>Leucocytozoon</i> × Sex		0.09	1,194	0.760	
Infection by <i>Leucocytozoon</i> × Age		0.19	1,194	0.664	
Age × Sex		0.02	1,194	0.884	
Growth bar width (94; 107)					
Final model					
Colony	0		1	>0.99	
Pair identity	1.2		1	0.273	
Infection by <i>Leucocytozoon</i>		0.07	1,197	0.796	0
Age		3.84	1,194	0.052	0.138
Sex		3.25	1,188	0.073	0.126
Excluded terms					
Infection by <i>Leucocytozoon</i> × Age		0.07	1,189	0.794	
Infection by <i>Leucocytozoon</i> × Sex		1.53	1,189	0.218	
Age × Sex		0.	1,189	0.950	