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APPARENT LACK OF EFFECTS OF A HIGH LOUSE-FLY INFESTATION (Diptera, Hippoboscidae) ON ADULT COLONIAL ALPINE SWIFTS.

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ABSTRACT A population of Alpine Swifts (*Apus melba*) showed the highest louse-fly parasitization rate (74%) as far as known in birds. This might be caused by a limited ability to preen. The prevalence was lower in second-year birds than in adults, probably as a result of their breeding status. Parasitization affected neither body condition, nor the probability of transmission of blood parasites. Due to mobility of louse flies, we suggest that heavy infestations have a short duration, and thus do not affect individual Swifts in terms of physical deterioration.

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INTRODUCTION

Recent studies on bird-parasite interactions reveal important negative effects of both ecto- and endoparasites on behaviour and fitness of their avian hosts (Loye & Zuck 1991, Lehman 1993). Individuals of group-living species incur a greater risk of getting parasites than solitary species (Poulin 1991), and parasitization is frequently considered as a cost of coloniality in birds (Hoogland & Sherman 1976, Brown & Brown 1986, Shields & Crook 1987, Moller 1987). These studies have mainly been carried out on parasites transmitted by contact, but very little is known on the effects of mobile ectoparasites, such as louse flies (Senar *et al.* 1994). Louse flies are blood-sucking parasites that may cause a reduction in their host's body condition (Senar *et al.* 1994). In Columbidae species they may also promote the transmission of blood parasites (Baker 1967). Our aim is to describe parasitism by louse flies in a colony of Alpine Swifts *Apus melba*, to check their possible effects on adult body condition, and to establish their role as blood parasite vectors.

METHODS

Field work was carried out in a colony situated in a chasm in Teruel, NE Spain. Birds were trapped by means of a hand-held mist-net maintained by two persons in horizontal position close to the ground. The net was raised when a bird tried to enter or leave the chasm, intercepting its flight. Captures were made in mid-July from 1991 to 1994. Nests were not accessible, but our data suggested that nestling stage was almost finished. All captured birds were ringed and measured by the same investigator (JLT), and an index of body condition was calculated as the residuals from the regression of weight on the cubed wing-length (Tella *et al.* 1995). Swifts were aged as second-calendar-year birds or adults (after second-year birds) following Cramp (1985). On 131 of the 153 trapped Swifts we systematically searched for ectoparasites. These searches were completed within 5-10 min. All parasites were collected and individually stored in tubes with 70% ethanol, to be identified in the laboratory later on. Prevalence (percentage of parasitized birds), mean intensity (number of parasites/parasitized birds) and relative density (number of parasites/total of sampled

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birds) were determined (Margolis *et al.* 1982). Thirty birds in 1992 and 10 in 1994 were selected to search for blood parasites. A drop of blood was taken from the bigger nail and smeared on individually marked slides, air-dried, fixed *in situ* in 100% methanol and later stained with Giemsa's stain. Hundred fields were checked under a 100× oil immersion objective. The 100 fields were chosen in a line from one end of the slide to the other to compensate for differences in blood thickness (Weatherhead & Bennett 1992). This method has been extensively used, and only blood parasites at undetectable levels (<1/100000 erythrocytes) could remain unnoticed.

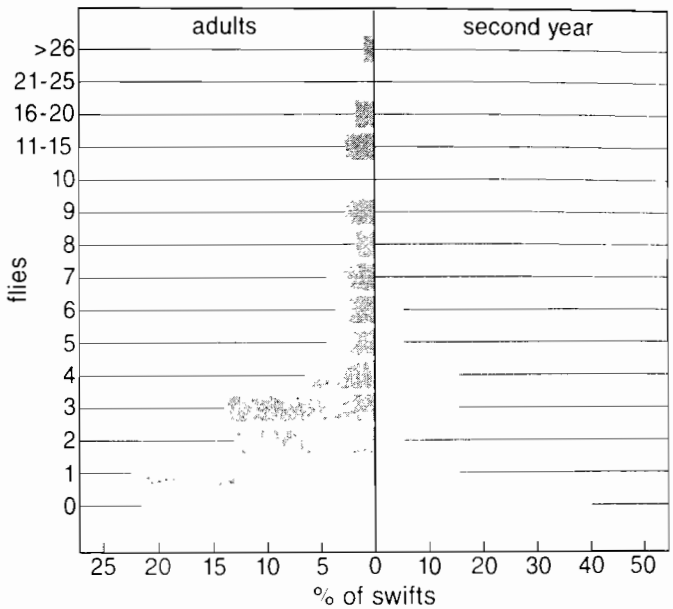

Fig. 1. Number of louse flies parasitizing adult and second-year Alpine Swifts.

RESULTS

Ninety-seven of 131 Alpine Swifts (74%) were parasitized by the Hippoboscidae fly *Crataerina melbae* (Rondani 1879). Other ectoparasites, Mallophaga and Acari, were found in 7 swifts (5.3%), so we only analyzed the parasitism rates by louse flies (Table 1). Prevalence was lower in second-year birds than in older birds ($\chi^2 = 6.94$, $df = 1$, $p = 0.008$), but did not differ between years ($\chi^2 = 6.12$, $df = 3$, $p = 0.10$). Number of flies ranged from 0 to 32, and the distribution of numbers of flies differed between second-year and older birds (Fig. 1). Intensity was similar in both age-classes (Table 1, Mann-Whitney *U*-test $z = -0.07$, $p = 0.93$), but relative density was greater in adults (Table 1, Mann-Whitney *U*-test $z = -2.06$, $p = 0.03$). Both intensity and relative density varied between years (Table 1, Kruskall-Wallis Anova, $z = 7.69$, $p = 0.05$ and $z = 11.51$, $p = 0.009$ respectively).

Looking for negative effects of louse-flies parasitism on body condition of Swifts, we did not

Table 1. Prevalence, intensity and relative density of louse flies on adult and second-year Alpine Swifts from 1991 to 1994.

	Prevalence		intensity		relative density	
	%	*n*	$\bar{x} \pm SD$	*n*	$\bar{x} \pm SD$	*n*
Age-class						
Adult	78.7	108	4.29±4.84	85	3.37±4.64	131
Second-year	52.2	23	3.08±1.62	12	1.60±1.94	23
Year						
1991	61.5	39	3.25±3.13	24	2.00±2.91	39
1992	81.5	65	4.84±5.55	53	3.95±5.35	65
1993	81.2	16	4.30±2.81	13	3.50±3.05	16
1994	63.6	11	1.57±0.53	7	1.00±0.89	11
Total	74.0	131	4.14±4.58	97	3.06±4.34	131

Table 2. Differences in body condition between louse fly infected and non-infected Alpine Swifts. Body condition is expressed as the residuals from the regression of weight on the cubed wing-length.

	Infected		Non-infected			
	$\bar{x} \pm SD$	n	$\bar{x} \pm SD$	n	Mann-Whitney U-Test	
Adult	0.14 ± 5.81	85	2.62 ± 7.03	23	$z = -1.30$	$p = 0.19$
Second-year	-3.21 ± 7.19	12	-3.09 ± 5.16	11	$z = 0.09$	$p = 0.93$
Pooled	-0.27 ± 6.06	97	0.77 ± 6.96	34	$z = -0.42$	$p = 0.67$

Table 3. Spearman correlations between body condition of Alpine Swifts and their parasitization rates (intensity and relative density) by louse flies.

	Age-class	r_s	p	n
Intensity	Adult	0.03	0.75	85
	Second-year	0.20	0.50	12
	Pooled	0.03	0.74	97
Relative density	Adult	-0.07	0.43	108
	Second-year	0.09	0.66	23
	Pooled	-0.01	0.86	131

find any significant differences between parasitized and unparasitized birds, both taking all individuals and separating age-classes (Table 2). The results remain the same if only the largest sample, the adult Swifts from 1992, are considered (Mann-Whitney U-test, $z = 0.64$, $df = 52$, $p = 0.52$). Body condition was not correlated to either the individual intensity or relative density of flies, considering age-classes or pooled birds (Table 3).

We did not find any blood parasite in the examined smears from 40 birds. However, 37 of them were parasitized by louse-flies.

DISCUSSION

Alpine Swifts showed a very high louse-fly prevalence (74%) so far never reported in other avian species, in which prevalences varied between 0 and 22%, usually about 3% (McClure 1984, Young *et al.* 1993, Senar *et al.* 1994, Tella unpubl.), except in a congeneric species, the European Swift *Apus apus*, whose parasite infestation rate was 34.4% (Hutson 1981). Empirical studies demonstrated that preening activity and its efficience in birds is related to their morphological characteristics (Clayton 1991, Clayton & Cotgreave 1994). Swifts have short and rather stiff tarsi and inappropriate necks for preening and scratching, and probably these features mean a strong handicap that allows high ectoparasite loads in this group of birds.

Interannual changes in Hippoboscid infestation rates are easily explained by metereological variations (Senar *et al.* 1994). Differences between second-year birds and adults, that have also been reported for the European Swift (Hutson 1981), are probably related to breeding status. In a Swiss Alpine Swift population only 7.1% of birds bred in their second year (Arn 1960 in Cramp 1985). Due to this fact, the contact with the colony and thus the risk of transmission could be lower.

The role of Hippoboscids as blood parasite vectors (Baker 1967) is not clear, since we did not

find any haematozoa in the forty sampled birds. This null prevalence cannot be related to seasonal variation (Weatherhead & Bennett 1991) or reproductive effort (Apanius 1991), because all birds were caught during the same nestling period. On the other hand, Ceratopogonids are well known as vectors of blood parasites (*Haemoproteus* and filariid worms) in birds (Fallis & Wood 1957, Bennett & Fallis 1960, Atkinson *et al.* 1983), and these sandflies were very common in the colony during the bird-trapping sessions. Since other searches for blood parasites in Alpine Swifts were unsuccessful (n = 42, Peirce 1981; n = 12, Earlé *et al.* 1991), we agree with Bennett *et al.* (1986) that the absence of blood parasites in this species could be explained by scarce exposure to vectors caused by their feeding and nesting habits.

Detrimental effects of contact-transmitted parasites on their avian hosts are well known (Loye & Zuk 1991). However, debilitating effects of mobile ectoparasites, like louse-flies, was only recently shown in adult Serins *Serinus serinus* (Senar *et al.* 1994). Prevalence of louse-flies in this species was very low (1.3%), but body condition of infected wintering Serins was lower than the mean body condition of parasite-free Serins. Alpine Swifts showed the highest Hippoboscid parasitization rates known in birds. However, we failed to find any effects of this parasitization on body condition of adults. This finding could be due to the limited sample size and to the fact that most birds were infected. However, Hutson (1981), by taking a larger sample (4094 birds), also failed to find that high infestations of louse-flies affected the weight of European Swifts. As suggested by this author, the lack of negative effects could be due to the possibility that flies frequently move between hosts. Heavy infestations will be of short duration, and all individuals could therefore suffer the same physical deterioration. Some support for this hypothesis might be derived from the recapture of an Alpine Swift that had been cleared of parasites the day before, but again carried three flies. The cliff-nesting habits of this species do not easily lead to sufficiently large sample sizes, recapturing, and a study of the effects of flies on nestling growth and survival. Nonetheless, inter-nest movements of louse-flies has been pointed out in other species (Popov 1965, Summers 1975, Tella unpubl.), and, therefore, infestations could also be equal for all the nests of the colony.

To conclude, we think that Alpine Swifts have high louse-fly loads because they are not morphologically able to avoid them. Moreover, the mobile behaviour of flies could cause a continous change in the number of flies in each bird. Consequently, differences in individual fitness in this species do not seem to be the result of louse fly infestation. Nevertheless, both our results and those from Senar *et al.* (1994) are only observational; experimental studies are needed for a better understanding of the relationships between louse flies and their bird hosts.

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SAMENVATTING

Een populatie Alpengierzwaluwen in Teruel (Noordoost-Spanje) vertoonde de hoogste infectiegraad (74%) met luisvliegen ooit bij vogels waargenomen. Dit zou veroorzaakt worden door de beperkte mogelijkheden om in de veren te pikken. De infectiegraad bij tweedejaarsvogels was lager dan die bij volwassen dieren, waarschijnlijk door hun status van niet-broedend. Het hebben van parasieten had geen effect op de conditie en ook niet op de kans van het overdragen van bloedparasieten. Omdat de luisvliegen nogal beweeglijk zijn, suggereren de onderzoekers dat de infectieduur slechts kort is. De Alpengierzwaluwen worden dus niet beinvloed in termen van achteruitgang in lichamelijke conditie.

H.d.N.