UDC [595.751+595.42]:598.2

THE PREVALENCE AND INTENSITY OF LOUSE (PHTHIRAPTERA, MALLOPHAGA) AND TICK (ACARINA: IXODIDAE) INFESTATION OF BIRDS IN SOUTH AFRICAN GRASSLANDS

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Received 22 December 2010
Accepted 30 March 2011

The Prevalence and Intensity of Louse (Pthiraptera, Mallophaga) and Tick (Acarina,Ixodidae) Infestation of Birds in South African Grassland. Kopij G., Price R. D. – A total of 270 birds represented by 12 species were examined for the presence of lice and ticks. Birds were collected in South African grasslands. Extensity of louse and tick infestation ranged from 10% to 80% and from 3% to 33% respectively. Average number of lice per host species ranged from 1 to 15, while average number of ticks per host species ranged from 1 to 5. Only single specimens (0.4%) were heavily parasited by lice and ticks respectively. Lice infested birds more often during the dry season, while ticks infested birds mainly during the rain season.

Key words: Pthiraptera, Ixodidae, prevalence, intensity, infestation, South Africa.

Превалирование и интенсивность зараженности птиц пухоедами (Pthiraptera, Mallophaga) и клещами (Acarina, Ixodidae) на пастбищах в Южной Африке. Копий Г., Прайс Р. Д. – В общей сложности 270 птиц 12 видов были обследованы на наличие пухоедов и клещей. Птицы были собраны на южноафриканских пастбищах. Экстенсивность зараженности пухоедами и клещами колеблется от 10% до 80% и от 3% до 33%, соответственно. Среднее количество пухоедов на вид-прокормитель колеблется от 1 до 15, а среднее число клещей на вид-прокормитель — от 1 до 5. Только единичные особи (0,4%) были сильно паразитированы пухоедами и клещами соответственно. Пухоеды заражали птиц чаще всего во время сухого сезона, в то время как клещи заражали птиц в основном во время сезона дождей.

Ключевые слова: Pthiraptera, Ixodidae, превалирование, интенсивность заражения, Южная Африка.

Introduction

Lice (Phthiraptera: Mallophaga), and mites and ticks (Acarina) are the most prevalent ectoparasites of African birds (Ledger 1980). To date, studies on African lice infesting birds were devoted mainly to taxonomy or host specificity (e. g. Ledger 1980, Walker 1991). Recently, Złotorzycka et al. (1999) have conducted morphometric studies on bird lice. The intensity and extensity of louse infestation in African birds have only been investigated in the Helmeted Guineafowl *Numida meleagris* L. 1758 (Louw et al. 1993). The present paper provides further data on lice and tick infestation of some bird species associated with South African grasslands.

Ticks (Arachnida, Acari, Ixodidae) in this region are very important vectors of serious viral, bacterial and protozooal diseases of both wild and domestic ungulates (Walker, 1991). They are temporary blood parasites and spend relatively short period on host. Depending on the number of hosts, they can be classified as one- or two-hosts ticks (Urquhart et al., 1987). The former group is widespread in Africa. Adult ticks belonging to this group parasite mammals, while nymphs are often parasites of birds. Although ticks parasiting mammals have been a subject of thorough investigation in Africa (e. g. Horak, Boomker, 1998; Horak et al., 1986, 1991 a,b), to date the role of birds in the life cycle of these disease-boring ticks is poorly understood. Most studies on African ticks (Acarina: Ixoidea) infesting birds are devoted to host specificity (e. g. Walker, 1991).

Table 1. Species, sex and age of lice infesting some bird species in South African grasslands
Таблица 1. Виды, пол и возраст пухоедов, поражающих некоторые виды птиц на пастбищах Южной Африки

Host species	Lice species			imm	total
Vanellus armatus	*Actornithophilus hoplopteri*	11	7		18
	Quadraceps chorleyi	8	26		34
Falco naumanni	*Kelerinirmus rufa*	10	7	28	45
Francolinus levaillantoides	*Amyrsidea powelli*	1			1
Francolinus swainsonii	*Amyrsidea powelli*		4	1	5
Eupodotis cafra	*Otidoecus sp.*			13	13
Smutsornis africanus	*Quadraceps princeps*	1			1
Burhinus capensis	*Quadraceps sp.*			2	2
Urocolius indicus	*Colimenopon sp.*			1	1
Spreo bicolor	*Brueeliinae*			1	1

Only Belozerov and Kopij [1997] investigated changes in stage structure of ticks *Argas arboreus* Kaiser, Hoogstraal et Kohls 1964, infesting colonial breeding Cattle Egret *Bubulcus ibis* L. 1758, while studies on the prevalence and intensity of tick infestation are limited to a few African bird species, such as the Helmeted Guineafowl, Cape Francolin *Francolinus capensis* (Gmelin, 1789), Grey-wing Francolin *Francolinus africanus* Stephens, 1819 and a few passerine species (Horak, Boomker, 1998; Horak et al., 1991 a,b). In this paper, further data are provided on tick infestation of some bird species associated with the grassland biome of South Africa.

Material and methods

Most birds were shot at Bloemfontein airport (29є 10'S, 26є 15'E) as a part of bird control program, in various months during the years 1994–1997 (Złotorzycka et al., 1998). The airport is amidst the Cymbopogon-Themeda Grasslveld, c. 10 km E of Bloemfontein city center, Free State, South Africa. Pied Starlings *Spreo bicolor* (Gmelin, 1789) were found poisoned on 10 November 1993 in the Excelsior district (28є 55'S, 27є 05'), Free State, while Wattled Starlings *Creatophora cinerea* (Meuschen, 1787) were shot on 8 September 1993 in Bloemfontein (n = 15) and were found poisoned (n = 11) in the Excelsior district.

Birds were placed in plastic bags and frozen within half an hour, after being shot. After thawing the carcasses were examined in a laboratory, with an aid of stereo microscope. Lice and ticks were searched for over the whole body, but especially carefully upon the head and wings. All lice and ticks found in one bird were placed in a bottle filled with 70% alcohol, and counted. Unlike in mammals, ticks infesting birds were not mature, but all were in nymphal stage of development. To date, no keys for African species in such stage are available (Walker, 1991) and it was impossible to identify them down to species level.

The prevalence (rate) of infestation is defined as a percentage of parasited birds in relation to the total number of birds examined. The intensity of infestation refers to the number of parasites per host.

Results

Lice infested all bird species examined, except the Wattled Starling. The extension of infestation ranged from 10% to 80% (table 2). The Lesser Kestrel *Falco naumanni* Fleischer, 1818 and some ground-dwelling species, such as the Orange River Francolin *Francolinus levaillantoides* (A. Smith, 1836), Swainson's Francolin *Francolinus swainsonii* (A. Smith, 1836) and Blacksmith Plover *Vanellus armatus* (Burchell, 1822) were more often infested than other species examined. However, the prevalence of the infestation was unexpectedly low in two other ground-dwelling species, namely the Black Korhaan *Eupodotis afraoides* (Dowsett et Dowsett-Lemaire, 1993), and the Spotted Dikkop *Burhinus capensis* (M.H.C. Lichtenstein, 1823) (table 2).

It has been shown that the extension of infestation in the Blacksmith Plover changed from month to month (Fig. 1), being high during the dry (April-September) and low during the wet season (October-March). A similar pattern is apparent in other species (fig. 2).

The number of lice per host ranged from 1 to 30 in most birds examined, while the average number of lice per host ranged from 1 to 15 depending on host species (table 3). Blacksmith Plovers and Lesser Kestrels had the largest burden of those

Table 2. Prevalence (percentage of birds infested) of louse infestation in South African birds.
Таблица 2. Преобладание (в процентах) заражения пухоедами птиц Южной Африки.

Host species	Lice	N
Falco naumanni	41.3	63
Francolinus levaillantoides	80.0	5
Francolinus swainsonii	66.7	3
Eupodotis cafra	18.4	38
Smutsornis africanus	50.0	4
Vanellus armatus	68.9	61
Burhinus capensis	13.6	22
Tyto alba	50.0	2
Urocolius indicus	10.0	10
Hirundo spilodera	16.7	12
Spreo bicolor	20.0	15
Creatophora cinerea	0.0	26
Total	33.6	261

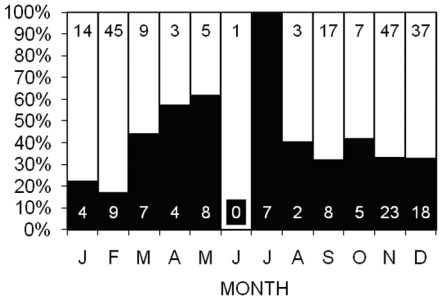

Fig. 1. Seasonal changes in lice infestation in the Blacksmith Lapwing occurring in South African grasslands. Number of birds investigated indicated above each column.

Рис. 1 Сезонные изменения заражения пухоедами Vanellus armatus, встречающегося на пастбищах Южной Африки. Количество исследованных птиц указано в верхней части колонки.

Table 3. Intensity of louse infestation (number of parasites per host) in South African birds. In brackets a number of lice in one heavily parasite specimen is given; N – number of birds investigated.

Таблица 3. Интенсивность заражения пухоедами (количество паразитов на хозяине) птиц Южной Африки. В скобках дано количество пухоедов на одном, тяжело пораженном, экземпляре; N – количество исследованных птиц.

Host			Number of lice		
Species	Sex	N	Mean	SD	Range
Vanellus armatus	Male	18	7.7	4.66	2-18
	Female	21	14.8	31.73	1-30 (150)
	Juvenile	2	8.5	7.78	3-14
	Total	41	12.0	22.96	1-30 (150)
Falco naumanni	Male	18	7.0	8.35	1-35
	Female	11	4.4	2.98	1-8
	Total	29	6.0	6.87	1-35
Francolinus levaillantoides	M+F	2	2.5	0.71	2-3
Francolinus swainsonii	M+F	2	3.0	1.41	2-4
Eupodotis cafra	M+F	7	2.3	2.56	1-8
Smutsornis africanus	Unknown	1	1.0	0.00	1
Burhinus capensis	M+F	3	1.7	0.58	1-2
Tyto alba	Unknown	1	1.0	0.00	1
Urocolius indicus	Unknown	1	2.0	0.00	2
Spreo bicolor	Unknown	2	3.3	2.31	2-6
Passer melanurus	Unknown	1	1.0	0.00	1
Total	M+F	90	7.6		1-35

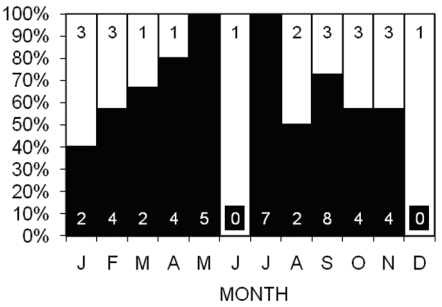

Fig. 2. Seasonal changes in lice infestation in birds (excluding the Blacksmith Lapwing) occurring in South African grasslands. Number of birds investigated indicated above each column.

Рис. 2. Сезонные изменения в заражении пухоедами птиц (исключая Vanellus armatus), встречающихся в Южной Африке.

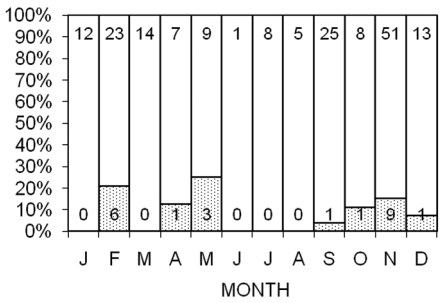

Fig. 3. Seasonal changes in tick infestation in birds occurring in South African grasslands. Numbers of birds investigated are indicated in the upper parts of each column.

Рис. 3. Сезонные изменения в поражении клещами птиц, встречающихся на пастбищах Южной Африки. Количество исследованных птиц указано в верхней части каждой колонки.

Table 4. Prevalence (percentage of birds infested) of tick infestation in South African birds.
Таблица 4. Преобладание (в процентах) поражения клещами птиц Южной Африки.

Host species	Percentage of birds infested	Number of birds examined
Falco naumanni	3.2	63
Francolinus levaillantoides	20.0	5
Francolinus swainsonii	33.3	3
Eupodotis afraoides	5.3	38
Smutsornis africanus	25.0	4
Vanellus armatus	0.0	61
Burhinus capensis	4.5	22
Tyto alba	0.0	2
Urocolius indicus	10.0	10
Hirundo spilodera	8.3	12
Spreo bicolor	6.7	15
Creatophora cinerea	11.5	26
Total	8.0	261

ectoparasites (x = 12 and x = 6 respectively). A Blacksmith Lapwing, collected in July, was heavily parasited by c. 150 lice. This bird did not show any signs of morphological deformation, as it is, sometimes, in the case of heavily parasited birds (Ash 1960). While females of the Blacksmith Lapwing were more often infested by lice than the males, in Lesser Kestrels the reverse was true (table 4).

Table 5. Intensity of tick infestation (number of nymphs per host) in South African birds.
Таблица 5. Интенсивность поражения клещами (количество нимф на хозяине) птиц Южной Африки.

Host species	Mean	SD	Range	N
Falco naumanni	5.0	2.83	3–7	2
Francolinus levaillantoides	50.0	0.00	-	1
Francolinus swainsonii	19.0	0.00	-	1
Eupodotis cafra	4.5	0.71	4–5	2
Smutsornis africanus	1.0	0.00	-	1
Burhinus capensis	1.0	0.00	–	2
Upupa epops	1.0	0.00	–	1
Urocolius indicus	1.0	0.00	–	1
Hirundo spilodera	1.5	0.71	1–2	2
Spreo bicolor	2.0	2.45	1–8	8
Creatophora cinerea	1.0	0.00	–	3
Total	4.8		1–8	24

All ticks found on birds were in nymphal stage of development. The prevalence of the infestation was low. The Blacksmith Lapwing and Barn Owl *Tyto alba* were not parasited by ticks at all (table 3). The mean number of ticks per host was 4.8 (table 3). A male of the Orange River Francolin, collected in May, had exceptionally large burden of ticks (*c.* 25 on the head and *c.* 25 in ears) and a male Swainson's Francolin was parasited by 19 ticks (4 in ears and 15 on the head). Birds infested by ticks were found from September to March, i.e. in the rainy season. It appears that they are more often parasited by ticks during the second half of this period (fig. 1).

Discussion

Ash (1960) tested the method employed in the present study and concluded that it may seriously underestimate the population size of ectoparasites. It is unknown, however, to what extent the method may underestimate the real number of lice, and, to lesser extent, the extension of the infestation. It is apparent that both intensity and extensity of ectoparasite infestation differ from one host species to another, and it may also depend on the way the birds were collected and preserved. If a bird was placed in a plastic bag and gradually frozen soon after being shot, as it was in this study, lice parasiting the bird could have migrated and eventually died on the latest cooling parts of the body, *i.e.* on the head. If parasites were carefully looked for on the head, then the underestimation may be markedly reduced.

It has been documented that the proportion of birds parasited by lice varies seasonally, from host to host species, between sexes and age classes of the host (Ash 1960, Horak et al., 1986, Horak et al., 1991, Louw et al. 1993). Usually lice infest more often males than females, and more often young than adult birds (Ash 1960), but in the Helmeted Guineafowl both sexes were equally (t-test, $p = 0.95$) heavy infested (calculation based on Horak, Williams, 1986). In the present study, Lesser Kestrel males were significantly more often parasited than females, while in the Blacksmith Lapwing females were more often infested than males (Table 3).

In Europe, the average number of ticks per avian host is rather low and usually falls below 10 (Złotorzycka, 1990). Larger number of these ectoparasites (40 ticks per host) indicates heavy infestation (Ash, 1960). This is, however, rare in nature. Meinerzhagen and Clay (1948) examined 15 000 wild birds and found less than 0.1% of them being heavily parasited. Most Helmeted Guineafowls examined had, however, a large burden of tick parasites (Horak et al., 1986). The prevalence of tick infestation in the Helmeted Guineafowl was 100% in all five areas, where these birds were investigated in South Africa. The mean number of ticks per host in these areas ranged from 33 to 647 with an overall average – 260 ticks per host (Horak, Boomker, 1998; Horak

et al., 1991 a). In six other avian species investigated in these areas, tick prevalence ranged from 60% to 90%, and their mean number per host varied from 3.0 to 9.6 (Horak, Boomker, 1998; Horak et al., 1991 b). In this study, out of 270 birds examined, only single specimens (0.4%) were heavily infested by ticks (Table 3).

In Europe the peak of lice infestation occurs in birds just prior the breeding season (Ash, 1960). Due to a small sample size, for most species examined during this study, it was difficult to show any pattern. In general, it appears that in South Africa lice infest more birds during dry (April-September) than wet season (October-March, i. e. when most birds breed). At least, this is true in the case of the Helmeted Guineafowl (Louw et al., 1993) and the Blacksmith Lapwing (Fig. 1).

The present study supports previous findings, that extension of louse infestation changes markedly from host to host species, e. g. extension of lice infestation in the Helmeted Guineafowl was estimated at 100% (Table 2); in the Ringed Pheasant *Phasianus colchicus* L. 1758 at 61%; in the Sand Martin *Riparia riparia* (L. 1758) at 16−54%, in the European Starling *Sturnus vulgaris* L. 1758 at 22% (Złotorzycka, 1990); in the Wagtail *Motacilla alba* L. 1758 at 13%, in the Robin *Erithacus rubecula* L. 1758 and Blackbird *Turdus merula* L. 1758 at 61% (Ash, 1960). Similarly, it has been shown that the extension of tick infestation changes markedly from host to host species, e.g. it was estimated at 50% in the European Jay *Garrulus glandarius* (L. 1758), but only at 4% in the Blue Tit *Parus caeruleus* L. 1758 (Złotorzycka, 1990). In South African birds, this infestation ranged from 3.2% to 100% (table 1−5).

It appears therefore that in African grasslands only some birds, probably the large terrestrial species from the Galliformes and Charadriformes, play an important role as hosts of nymphal ticks, other species are infested rather accidentally and there seems to be reasonable number of bird species which are resistant to tick infestation. Further studies on tick infestation in other bird species are however needed to define the groups more precisely.

In Europe, the average number of lice and ticks per avian host is rather low and usually falls below 10 (Złotorzycka, 1990). Larger number of ectoparasites (40 or more lice or ticks per host) indicates heavy infestation (Ash, 1960). This is, however, rare in nature. Meinerzhagen and Clay (1948) examined 15 000 wild birds and found less than 0.1% of them being heavily parasited. Most Helmeted Guineafowls examined had, however, a large burden of lice and ticks (table 4). In this study out of 270 birds examined, only single specimens (0.4%) were heavily infested by lice and ticks respectively.

Ash (1960) tested the method employed in the present study and concluded that it may seriously underestimate the population size of ectoparasites. For ticks, the search procedure is, however, not so much biased as those arthropods are relatively large and much more permanently attached to the host's body than for example lice.

It has been shown that the prevalence of tick infestation changes markedly from host to host species, e. g. it was estimated at 50% in the European Jay, but only at 4% in the Blue Tit (Złotorzycka, 1990). In South African birds, this range is even wider (0−100%). Some bird species appear to be especially prone to tick infestation, others seem to be resistant. In Europe, the Dunnock *Prunella modularis* (L. 1758) was found to be resistant to tick infestation (Zucchi, 1979). This study suggests that similar situation may exist in the Blacksmith Plover, and to lesser extend in the Black Korhaan *Eupodotis afraoides* (Dowsett et Dowsett-Lemaire, 1993) and Spotted Dikkop *Burhinus capensis* (M.H.C. Lichtenstein, 1823) in South African grasslands. On the other hand, the Helmeted Guineafowl is well-known as very important host of immature ixodid ticks (Horak et al., 1986).

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It appears therefore that in African grasslands only some birds, probably the large terrestrial species from the Galliformes and Charadriformes, play an important role as hosts of nymphal ticks, other species are infested rather accidentally and there seems to be reasonable number of bird species which are resident to tick infestation. Further studies on tick infestation in other bird species are however needed to define the groups more precisely.

The material was obtained through a kind co-operation of the University of the Free State and the Bloemfontein airport. My thanks are due to Prof. O. B. Kok for collecting and preserving the birds. Prof. Horak from the Onderstepoort Vet Inst, South Africa is gratefully acknowledged for his comments and improvements on earlier draft of this paper.

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