



## Parasites of domestic and wild animals in South Africa. XLIV. Fleas (Insecta: Siphonaptera: Pulicidae) collected from 15 carnivore species

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### ABSTRACT

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Fleas were collected from 61 wild carnivores belonging to 13 species in various nature reserves and on farms, two feral domestic cats in a nature reserve and a domestic dog in the city of Johannesburg. Eleven flea species, including two subspecies of one of these, belonging to six genera were recovered. Amongst these only *Ctenocephalides felis felis* and *Ctenocephalides felis strongylus* are considered specific parasites of carnivores. The remaining ten species normally infest the prey animals of the various carnivores.

**Keywords:** Carnivores, fleas, Pulicidae, Siphonaptera, South Africa

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### INTRODUCTION

For the past 30 years ectoparasites have been collected from a variety of wild carnivores in surveys aimed at determining the species composition of the arthropods that infest them. The tick species recovered from carnivores in two of these surveys have been recorded by Horak, Jacot Guillarmod, Moolman & De Vos (1987) and Horak, Braack, Fourie & Walker (2000), as have the ticks, mites, fleas and lice infesting yellow mongooses, *Cynictis penicillata* (Horak, Chaparro, Beaucournu & Louw

1999). This paper lists the remaining fleas collected during the surveys.

### MATERIALS AND METHODS

The procedures followed for the collection of ectoparasites have been described by Horak *et al.* (2000) and, but for certain details, will not be repeated here.

The material collected by vigorous scrubbing of the skins of the dead animals was preserved in 10 % formalin until it was examined microscopically and the ectoparasites so detected were transferred to 70 % alcohol. The prior storage in formalin made specific identification of delicate structures of some fleas impossible, and consequently if there was any doubt as to the identity of a flea it was excluded from our findings. The carnivore species and the localities at which they were examined are listed in Table 1. In addition, we received fleas collected from a domestic dog in Johannesburg, Gauteng Province.

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TABLE 1 Carnivores and the localities at which they were examined for fleas

Carnivore species		No. examined	Locality or province
Common name	Scientific name		
Domestic dog	<i>Canis familiaris</i>	1	Johannesburg, Gauteng
Black-backed jackal	<i>Canis mesomelas</i>	5	KNP, central Free State, north-western Northern Cape, Eastern Cape
Cheetah	<i>Acinonyx jubatus</i>	3	KNP
Caracal	<i>Caracal caracal</i>	52	South-western Free State, north-western Northern Cape, Eastern Cape
Feral domestic cats	<i>Felis catus</i>	7	KNP
African wild cat	<i>Felis lybica</i>	3	KNP, south-western Free State, north-western Northern Cape
Lion	<i>Panthera leo</i>	23	KNP, north-eastern KwaZulu-Natal
Leopard	<i>Panthera pardus</i>	5	KNP, Gauteng
White-tailed mongoose	<i>Ichneumia albicauda</i>	2	KNP
Meercat	<i>Suricata suricatta</i>	1	North-western Northern Cape
Spotted hyaena	<i>Crocuta crocuta</i>	9	KNP, north-eastern KwaZulu-Natal
Aardwolf	<i>Proteles cristatus</i>	2	South-western Free State, Eastern Cape
Honey badger	<i>Mellivora capensis</i>	9	KNP, northern Northern Cape, Western Cape
Civet cat	<i>Civettictis civetta</i>	6	KNP, north-eastern Mpumalanga
Large-spotted genet	<i>Genetta tigrina</i>	8	KNP, north-eastern Mpumalanga

KNP = Kruger National Park

## RESULTS AND DISCUSSION

Besides the single domestic dog, fleas were collected from 13 species of wild carnivore as well as from two feral domestic cats. Eleven flea species and two subspecies of one of these were recovered, and the various hosts and their flea burdens are summarized in Table 2.

## PULICIDAE

### Archaeopsyllinae

Genus: *Ctenocephalides*

Five taxa of this flea occur in South Africa and three of these were collected, namely *Ctenocephalides damarensis*, *Ctenocephalides felis felis* and *Ctenocephalides felis strongylus*. Of the remaining two, *Ctenocephalides canis* is not only rare, but is essentially a parasite of palearctic carnivores (in South Africa only the domestic dog fulfils this requirement). Moreover, it and *C. felis strongylus* that infests dogs in this country have often been confused. The other, *Ctenocephalides connatus*, is a parasite of yellow mongooses, suricates, *Suricata suricatta* and ground squirrels, *Xerus inauris* (De Meillon, Davis & Hardy 1961; Segerman 1995; Horak *et al.* 1999). As we examined only one suricate its absence is not surprising.

Besides infestation of several animals by the inevitable "stragglers", the numerous collections of *C. damarensis* confirm that the preferred host of this flea, the scrub hare, *Lepus saxatilis*, constitutes a regular prey item for several carnivore species. As far as we can ascertain this is the first time that this flea has been recorded from *Acinonyx jubatus*, *Caracal caracal*, *Felis catus* (feral), *Panthera leo*, *Panthera pardus*, *Ichneumia albicauda*, *Proteles cristatus*, *Mellivora capensis*, *Civettictis civetta* and *Genetta tigrina*.

Extensive surveys of ectoparasites infesting *L. saxatilis* have been conducted at six widely separated localities in South Africa (Louw, Horak & Braack 1993; Louw, Horak, Horak & Braack 1995). Of the 560 scrub hares examined 449 were infested with *C. damarensis*, which at the time were identified as *C. felis damarensis*, and the mean burden of infested animals was 12.6 fleas. Beaucournu & M n n n (1998) have, however, demonstrated that these fleas are not a subspecies of *C. felis* but a well-founded species, namely *C. damarensis*. Furthermore, we have removed ten fleas of this species from flannel strips used for the collection of free-living ticks from the vegetation in the Kruger National Park (KNP). Thus, not only are a large percentage of prey animals infested with *C. damarensis*, but there are also several off-host "stragglers" present in the environment, resulting in the high prevalence of infestation on carnivores. Some fleas continue to

TABLE 2 Fleas collected from wild carnivores, feral domestic cats and a domestic dog in South Africa

Host species	No. examined	Species, gender and number of fleas collected (No. of hosts infested)							
		<i>Ctenocephalides</i> spp.		<i>Echidnophaga</i> spp.		<i>Procliviopsylla</i> spp.		Other species	
		Male	Female	Male	Female	Male	Female	Male	Female
		<i>C. damarensis</i>		<i>E. larina</i>		<i>P. creusae</i>		<i>M. sjoestedti</i>	
<i>C. mesomelas</i>	5			0	2 (1)	0	1 (1)		
<i>A. jubatus</i>	3	1	4 (1)	1	2 (1)			0	1 (1)
<i>C. caracal</i>	52	22	44 (11)	0	1 (1)	9	13 (5)		
<i>F. catus</i>	7	3	4 (2)			<i>P. angolensis</i>			
<i>F. lybica</i>	3	1	2 (1)			1	0 (1)		
<i>P. leo</i>	23	8	17 (5)	3	6 (4)			0	1 (1)
<i>P. pardus</i>	5	1	5 (1)	1	1 (1)				
<i>I. albicauda</i>	2	3	14 (1)						
<i>C. crocuta</i>	9			1	1 (1)				
<i>P. cristatus</i>	2	1	3 (1)	<i>E. gallinacea</i>				<i>S. caffer</i>	
<i>M. capensis</i>	9	1	6 (1)	1	4 (1)			0	6 (3)
<i>C. civetta</i>	6	8	12 (3)					<i>X. brasiliensis</i>	
<i>G. tigrina</i>	8	5	4 (2)					3	2 (1)
<i>C. familiaris</i>	1	<i>C. felis felis</i>							
		5	12 (1)						
		<i>C. felis strongylus</i>						<i>P. divergens</i>	
<i>C. caracal</i>	52	7	5 (3)	7	28 (10)	5	11 (3)		
<i>S. suricatta</i>	1			<i>E. bradyta</i>					
				1	2 (1)				

live, and even thrive, on accidentally infested felid or viverrid hosts. In Europe *Ceratophyllus sciuro-rum*, a very common flea of squirrels, survives on secondarily infested mustelids (Smit 1966; Beaucournu 1973, 1982).

The only *C. felis felis* identified in the present study were five males and 12 females taken from a Maltese poodle, which lived with its owners in an apartment in Johannesburg. We have been unable to determine the origin of these fleas.

*Ctenocephalides felis strongylus* is widespread in South Africa, but is only common on domestic dogs

in rural areas. The taxonomic features accepted by Beaucournu & Ménier (1998) for this species do not permit differentiation between its females and those of *C. damarensis*. Hence the numbers of females listed for the two species may not be exact. *Ctenocephalides felis strongylus* is found only exceptionally on wild hosts, implying that the latter are secondarily infested, probably by "stragglers" from domestic dogs (Segerman 1995). Its rarity on wild hosts may, however, be artificial rather than actual, in that it has often been confused with other *Ctenocephalides* spp., particularly *C. damarensis* as discussed above. Only three collections of *C.*

*felis strongylus* were made; all from caracals in the Eastern Cape Province, two in the coastal region and one in the Karoo.

## Pulicinae

Genus: *Echidnophaga*

*Echidnophaga gallinacea* and *Echidnophaga larina* do not normally infest carnivores, but represent infestations acquired from their prey. *Echidnophaga bradyta* on the other hand has secondarily adapted to certain carnivores, in particular *S. suricatta* and *C. penicillata* (Segerman 1995; Horak *et al.* 1999). A new species, *Echidnophaga suricatta*, that specifically infests *S. suricatta* has, however, recently been described (Hastriter 2000).

*Echidnophaga gallinacea* is primarily a parasite of rodents, but has also been found on a number of other small mammals and on birds (Segerman 1995). No *E. gallinacea* were, however, recovered from 92 rodents examined over a period of 2 years in the southern regions of the KNP (Braack, Horak, Jordaan, Segerman & Louw 1996). Warthogs, *Phacochoerus africanus*, are the preferred hosts of *E. larina* and 46 of 51 warthogs examined in the KNP were infested with a total of 12 932 *E. larina* and *Phacopsylla inexpectata* (the latter at the time identified as *Echidnophaga inexpectata*) (Beaucournu & Horak 1994). The fleas belonging to these two species could not be counted separately because we were unable to dislodge many of them from their firm attachment in the skin on the softer undersides of the warthogs and they had to be counted *in situ* (Horak, Boomker, De Vos & Potgieter 1988). Cheetahs, lions, leopards and hyaenas probably acquire infestation with *E. larina* when catching and devouring warthogs, whereas jackals could become infested either from catching young warthogs, or scavenging on the remains of warthogs killed by the larger carnivores, or even while sheltering in recently vacated warthog burrows.

## Xenopsyllinae

Genus: *Procaviopsylla*

Fleas of this genus are parasites of hyraxes, and secondarily of the predators of these animals. The three species of *Procaviopsylla* present in South Africa (*Procaviopsylla angolensis*, *Procaviopsylla creusae* and *Procaviopsylla divergens*) are all represented in our collections. In South Africa they parasitize the rock hyrax, *Procavia capensis*, but

according to De Meillon *et al.* (1961) it is possible that specimens of *P. angolensis* that they studied came from *Dendrohyrax* (= *Heterohyrax*) *brucei*. The distribution of the carnivores infested in the present study, namely caracals, jackals and feral cats overlaps that of hyraxes.

A total of 2 197 *P. creusae* were collected from 76 of 77 rock hyraxes examined in the Mountain Zebra National Park, Eastern Cape Province (Horak & Fourie 1986), and some of the caracals in the present study came from this park. However, to state "In fact, the caracal is the type host of this flea" as was done by Horak & Fourie (1986) is misleading as to the identity of the preferred host. Although *P. creusae* was originally collected and described from caracals, these animals are certainly not the preferred hosts. Haeselbarth, Segerman & Zumpt (1966) stated "This is the common parasite of the Rock Dassie (*Procavia capensis*)...Only a few stragglers have been found on rodents, the Caracal Lynx (*Felis caracal*, the type host) and even the Pied Starling (*Spreo bicolor*)". The designation of a type host, which is not also the preferred host is a common problem, particularly with fleas.

Genus: *Xenopsylla*

With rare exceptions fleas of this genus infest rodents. Thirty-one of 46 *Aethomys chrysophilus* examined in the KNP were infested with a total of 170 *Xenopsylla brasiliensis* and 23 of 46 *Tatera leucogaster* with a total of 140 *Xenopsylla frayi* (Braack *et al.* 1996). The five *X. brasiliensis* collected from one of the large spotted genet represent a secondary infestation of a predator by the fleas of its prey.

Genus: *Synosternus*

Host-specificity in fleas of this genus varies according to species. Their preferred hosts are rodents, lagomorphs and medium-sized carnivores such as viverrids, small felids and wild dogs. The principal host of *Synosternus caffer* is the springhare, *Pedetes capensis*. Although springhares are widespread in South Africa the distribution of *S. caffer* is restricted to the more western arid regions of the country (Segerman 1995). The only animal on which we found fleas of this species was the honey badger, *Mellivora capensis*, which is an omnivore. It would usually not be capable of catching a springhare unless it had dug open their burrows and caught their young, thus acquiring infestation from its prey or otherwise via "straggling" by fleas within

the burrow. The presence of *S. caffer* on eight of 20 yellow mongooses examined in the semi-arid region of Kuruman in the Northern Cape Province (Horak *et al.* 1999), can be attributed to "straggling" because springhare warrens are frequently used as shelters by various mongoose species (Skinner & Smithers 1990).

### Moeopsyllinae

Genus: *Moeopsylla*

This genus contains the single species *Moeopsylla sjoestedti*, a specific parasite of warthogs (Segerman 1995). It could thus secondarily infest large carnivores such as lions and leopards that prey upon these animals. A total of 143 fleas of this species were collected from 23 of 51 warthogs examined in the KNP (Horak *et al.* 1988).

### General

Unlike the Holarctic region, where fleas of the genus *Chaetopsylla* (Vermipsyllidae) specifically infest carnivores, it would appear that, with the exception of certain *Ctenocephalides* species and perhaps *E. suricatta*, fleas that infest carnivores within the Afro-tropical region are not specific parasites of these animals. A similar situation pertains in the Oriental region, where only *Ctenocephalides orientis* specifically infests carnivores. In the Neotropical region, however, certain fleas of the family Rhopalopsyllidae, or the subfamily Rhopalopsyllinae are frequently found on carnivores, and their host specificity appears extensive, with various families and genera of fleas infesting different families and genera of hosts.

A significant contribution to our understanding of the fleas of the southern African region can be attributed to research on the vectors of plague (De Meillon *et al.* 1961; Segerman 1995), in the epidemiology of which carnivores and their specific fleas are of generally little direct importance. However, in this context their "accidental" flea fauna may be of greater significance. The presence on a predator of a rodent-specific flea, of which the preferred host is presumably absent from a region, should encourage mammalogists to continue searching for the host in that region.

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### REFERENCES

- BEAUCOURNU, J.-C. 1973. Notes sur les Siphonaptères parasites de Carnivores en France. *Annales de Parasitologie Humaine et Comparée*, 48:497–516.
- BEAUCOURNU, J.-C. 1982. Les Siphonaptères et leurs hôtes: rapports phylétiques, convergences et déviations. *Deuxième Symposium sur la spécificité parasitaire des parasites de vertébrés, Paris 1981, Mémoires du Muséum National d'Histoire Naturelle, (n.s.), série A, Zoologie*, 123:203–208.
- BEAUCOURNU, J.-C. & HORAK, I.G. 1994. *Phacopsylla* gen. nov. for *Echidnophaga inexpectata* Smit, 1950 (Siphonaptera, Pulicidae). *Journal of African Zoology*, 108:133–141.
- BEAUCOURNU, J.-C. & MÉNIER, KARINE 1998. Le genre *Ctenocephalides* Stiles & Collins, 1930 (Siphonaptera, Pulicidae). *Parasite*, 5:3–16.
- BRAACK, L.E.O., HORAK, I.G., JORDAAN, LEONORA C., SEGERMAN, JOYCE & LOUW, J.P. 1996. The comparative host status of red veld rats (*Aethomys chrysophilus*) and bushveld gerbils (*Tatera leucogaster*) for epifaunal arthropods in the southern Kruger National Park, South Africa. *Onderstepoort Journal of Veterinary Research*, 63:149–158.
- DE MEILLON, B., DAVIS, D. & HARDY, F. 1961. *Plague in Southern Africa. Vol. 1. The Siphonaptera (excluding Ischnopsyllidae)*. Pretoria: Government Printer.
- HAESELBARTH, E., SEGERMAN, J. & ZUMPT, F. 1966. *The arthropod parasites of vertebrates in Africa south of the Sahara (Ethiopian Region). Vol. III. (Insecta excl. Phthiraptera)*. Johannesburg: Publications of the South African Institute for Medical Research, No. 52.
- HASTRITER, M.W. 2000. *Echidnophaga suricatta* (Siphonaptera: Pulicidae), a new species of flea from the Northern Cape Province, South Africa. *African Zoology*, 35:77–83.
- HORAK, I.G. & FOURIE, L.J. 1986. Parasites of domestic and wild animals in South Africa. XIX. Ixodid ticks and fleas on rock dassies (*Procavia capensis*) in the Mountain Zebra National Park. *Onderstepoort Journal of Veterinary Research*, 53:123–126.
- HORAK, I.G., JACOT GUILLARMOD, AMY, MOOLMAN, L.C. & DE VOS, V. 1987. Parasites of domestic and wild animals in South Africa. XXII. Ixodid ticks on domestic dogs and on wild carnivores. *Onderstepoort Journal of Veterinary Research*, 54:573–580.
- HORAK, I.G., BOOMKER, J., DE VOS, V. & POTGIETER, F.T. 1988. Parasites of domestic and wild animals in South Africa. XXIII. Helminth and arthropod parasites of warthogs, *Phacochoerus aethiopicus*, in the eastern Transvaal Lowveld. *Onderstepoort Journal of Veterinary Research*, 55: 145–152.

- HORAK, I.G., CHAPARRO, F., BEAUCOURNU, J.-C. & LOUW, J.P. 1999. Parasites of domestic and wild animals in South Africa. XXXVI. Arthropod parasites of yellow mongooses, *Cynictis penicillata* (G. Cuvier, 1829). *Onderstepoort Journal of Veterinary Research*, 66:33–38.
- HORAK, I.G., BRAACK, L.E.O., FOURIE, L.J. & WALKER, JANE B. 2000. Parasites of domestic and wild animals in South Africa. XXXVIII. Ixodid ticks collected from 23 wild carnivore species. *Onderstepoort Journal of Veterinary Research*, 67:239–250.
- LOUW, J.P., HORAK, I.G. & BRAACK, L.E.O. 1993. Fleas and lice on scrub hares (*Lepus saxatilis*) in South Africa. *Onderstepoort Journal of Veterinary Research*, 60:95–101.
- LOUW, J.P., HORAK, I.G., HORAK, M. LOUISE & BRAACK, L.E.O. 1995. Fleas, lice and mites on scrub hares (*Lepus saxatilis*) in Northern and Eastern Transvaal and in Kwa-Zulu-Natal, South Africa. *Onderstepoort Journal of Veterinary Research*, 62:133–137.
- SEGERMAN, JOYCE 1995. *Siphonaptera of southern Africa. Handbook for the identification of fleas*. Johannesburg: Publications of the South African Institute for Medical Research, No. 57.
- SKINNER, J.D. & SMITHERS, R.H.N. 1990. *Mammals of the southern African subregion*. Pretoria: University of Pretoria.
- SMIT, F.G.A.M. 1966. Siphonaptera. *Insecta Helvetica, Catalogus* 1: 1–107.