NORTH SPAIN (BURGOS) WILD MAMMALS ECTOPARASITES

DOMÍNGUEZ G.*

Summary:

Twenty-seven species of arthropods were collected from 105 wild mammals, six wolves *Canis lupus* (Linnaeus, 1758) included. A total of 87 animals (82,8 %) harboured some ectoparasites. Ticks were found in 60 % of the samples, fleas in 51.4 %, chewing-lice in 3.8 %, and others (*Mesostigmata* and hippoboscids) in 3.8 %. Moreover, 42.5 % were single infestation and 57.5 % mixed. Some of the species were new records for a host in spanish country such as *Trichodectes canis* (De Géer, 1778), *Ixodes trianguliceps* (Birula, 1895), *Ceratophyllus* (*Monopsyllus*) *S. sciurorum* (Schrunk, 1803) and *Paraceras melis melis* (Walker, 1856) on several mammals. Two species were new records for Spain: *Chaetopsylla matina* (Jordan, 1925) and *Archaeopsylla erinacei erinacei* (Bouché, 1835).

KEY WORDS : wild mammal, tick, flea, Chewing-Lice, parasitic prevalence, Spain.

Résumé :

ECTOPARASITES DE MAMMIFÈRES SELVATIQUES DU NORD DE L'ESPAGNE (BURGOS)

Vingt-sept espèces d'arthropodes ont été recueillies sur 105 exemplaires de mammifères selvatiques, dont six loups *Canis lupus* (Linnaeus, 1758). Un total de 87 animaux (82,8 %) n'avaient aucun ectoparasite. Des tiques ont été trouvés dans 60 % des cas, des puces dans 51,4 %, des mallophages dans 3,8 % et d'autres (*Acari*, *Mesostigmata* et hippoboscides) dans 3,8 %. De même 42,5 % représentaient des infections simples et 57,5 % mixtes. Quelques espèces sont des hôtes pour la première fois référencés en Espagne : *Trichodectes canis* (De Géer, 1778), *Ixodes trianguliceps* (Birula, 1895), *Ceratophyllus* (*Monopsyllus*) *S. sciurorum* (Schrunk, 1803) et *Paraceras melis melis* (Walker, 1856). Deux espèces sont des références nouvelles pour l'Espagne : *Chaetopsylla matina* (Jordan, 1925) et *Archaeopsylla erinacei erinacei* (Bouché, 1835).

MOTS CLÉS : mammifère selvatique, tique, puce, mallophage, prévalence parasitaire, Espagne.

Some arthropods play an important role in causing clinical disorders in man and animals, as acting as vectors of important diseases. However, few zoological studies, including hosts, distribution, ecology, and other factors on ectoparasites in wild animals, have been published.

In Spain revisions have been made by Gil Collado (1949, 1976); Sanchez Acedo *et al.* (1973); Beaucournu *et al.* (1973, 1990); Gilot *et al.* (1976); Martin (1977); Martinez *et al.* (1978); Encinas (1986); Estrada-Peña (1992) and Cordero del Campillo *et al.* (1994). Nevertheless, Estrada-Peña summarizes the present state of ticks knowledge and in the same way of other ectoparasites in Spain as discouraging and frustrating, keeping unstudied many Spanish areas and having an unfinished picture of the wild animal ectoparasites species. Other european authors carried out similar works, Beaucournu & Launay (1990) and Aubert (1975) in France, Harris *et al.* (1978) and Hillyard (1996) in the UK, Travassos (1994) in Portugal, Manilla (1998) in

Italy, Schöffel *et al.* (1991) in Germany and others, some of them as the fox, *Vulpes vulpes* (Linnaeus, 1758), focused on specific areas, hosts or ectoparasites. This paper wishes to contribute to the knowledge of the distribution of vertebrate ectoparasites in a previously studied area, by extending the sampling zone, the number of investigated hosts (some of them only slightly studied as the wolf) and parasites and the study length. Moreover, the study zone is a biogeographical transitional area and has a great biological diversity.

MATERIALS AND METHODS

The study zone averages 5,000 km² includes a northern strip of Burgos province at 42° 30' N-43° 10' N. Altitude ranging between 600-800 m on the plateau, and more than 1,100 m on the mountain foothills. In the northern sector, the winters are cold and humid and the summers are cool. Vegetation, under Atlantic influences, consists in oakwood and beechwood, with brushwood. The southern sector, submediterranean, shows similar winter, but hottest summers. Vegetation consists mainly in gall-oak groves

* Servicio Veterinario Oficial de Salud Pública, Centro de Salud, 09572-Soncillo, Burgos, Spain.

Correspondence: Gerardo Domínguez Peñafiel.

Tel.: 34 947 15 31 81 – Fax: 34 947 15 31 52.

E-mail: phetin@telefonica.net

and holm-oak wood, being brush scarce (Roman *et al.*, 1996).

All the animals come from the study area and were collected between August 1997 and December 2000. Most of them, 96, were killed on roads, five were hunted, and four died on the Burgos Wildlife Recovery Centre. They were identified, being included into 17 species: wolf *Canis lupus* (Linnaeus, 1758) 6, fox *Vulpes vulpes* (Linnaeus, 1758) 26, stone marten *Martes foina* (Erxleben, 1777) 6, pine marten *Martes martes* (Linnaeus, 1758) 1, polecat *Mustela putorius* (Linnaeus, 1758) 7, weasel *Mustela nivalis* (Linnaeus, 1758) 2, stout *Mustela erminea* (Linnaeus, 1758) 1, badger *Meles meles* (Linnaeus, 1758) 7, wild cat *Felis silvestris* (Schreber, 1775) 6, genet *Genetta genetta* (Linnaeus, 1758) 1, roe deer *Capreolus capreolus* (Linnaeus, 1758) 4, hedgehog *Erinaceus europaeus* (Linnaeus, 1758) 22, mole *Talpa europaea* (Linnaeus, 1758) 2, hare *Lepus europaeus* (Pallas, 1778) 4, red squirrel *Sciurus vulgaris* (Linnaeus, 1758) 7, fat dormouse *Glis glis* (Linnaeus, 1766) 2 and field vole *Microtus arvalis* (Linnaeus, 1758) 1.

After being identified, the animals were placed in plastic bags, containing an insecticide or ether. The ectoparasites recovered were placed in labelled vials containing 70 % alcohol or were stored at 4° C. Parasites were examined by means of a stereoscopic magnifying glass and a microscope. Except for the adult ticks and immature stages, fleas and lice were treated with KOH 10 % solution and were mounted in Hoyer's or Berlese's mediums.

Parasites were identified by the keys of Hopkins *et al.* (1953), Smit (1957), Hutson (1984), Beaucournu & Launay, (1990), Hillyard (1996) and Manilla (1998). *Mesostigmata* were only reported.

RESULTS

The study revealed (Table I) that 87/105 (82.8 %) of the animals were infested with ectoparasites.

The parasitic prevalence in each taxa was 60 % for ticks, 51.4 % for fleas, 3.8 % for lice and 3.8 % for others (*Mesostigmata* and hippoboscids).

Single parasitisation was observed on 37 samples (42.5 %) and mixed parasitisation was more frequent, being observed on 50 samples (57.5 %). Of the mixed, 30 samples (60 %) of the specimens had two ectoparasites species, 14 samples (28 %) three and six samples (12 %) four. The host which showed more mixed infection was the hedgehog with 14 specimens (77.7 %) of parasited animals. Nevertheless, the wider variety of arthropods were observed on a badger with two ticks species and one flea and lice taxa.

The highest parasitic prevalence was observed on red squirrel, fox, wild cat, hedgehog, badger and wolf, being 85.7 %, 84.6 %, 83.3 %, 81.8 %, 100 % and 100 % respectively, although they were also the most frequent examined species. The badger and the wolf were the only hosts showing parasitisation by some arthropods taxa steadily. Therefore, 63 animals (60 %) showed ticks, 54 animals (51.4 %) fleas, four animals (3.8 %) lice and

Examined animals hosts	T	Ticks		Fleas		Lice		Others		Parasitized animals	
		n	P %	n	P %	n	P %	n	P %	n	P %
<i>Canis lupus</i>	6	3	50.0	4	66.6	1	16.6	—	—	6	100.0
<i>Vulpes vulpes</i>	26	19	73.0	13	50.0	—	—	—	—	22	84.6
<i>Felis silvestris</i>	6	4	66.6	4	66.6	—	—	—	—	5	83.3
<i>Meles meles</i>	7	5	71.4	6	85.7	3	42.8	—	—	7	100.0
<i>Martes foina</i>	6	2	33.3	4	66.6	—	—	—	—	4	66.6
<i>Martes martes</i>	1	—	—	1	100.0	—	—	—	—	1	100.0
<i>Mustela nivalis</i>	1	—	—	—	—	—	—	—	—	—	—
<i>Mustela putorius</i>	7	1	14.2	1	14.2	—	—	1	*14.2	3	42.8
<i>Mustela erminea</i>	2	1	50.0	—	—	—	—	—	—	1	50.0
<i>Genetta genetta</i>	1	1	100.0	—	—	—	—	—	—	1	100.0
<i>Capreolus capreolus</i>	4	4	100.0	—	—	—	—	1	**25.0	4	100.0
<i>Lepus europaeus</i>	4	4	100.0	—	—	—	—	—	—	4	100.0
<i>Sciurus vulgaris</i>	7	4	57.1	5	71.4	—	—	—	—	6	85.7
<i>Glis glis</i>	2	—	—	2	100.0	—	—	—	—	2	100.0
<i>Microtus arvalis</i>	1	—	—	—	—	—	—	1	*100.0	1	100.0
<i>Talpa europaea</i>	2	—	—	2	100.0	—	—	1	*50.0	2	100.0
<i>Erinaceus europaeus</i>	22	15	68.0	12	54.5	—	—	—	—	18	81.8
Total hosts:	105	63	60.0	54	51.4	4	3.8	4	3.8	87	82.8

T: Total hosts. n: Number of parasited animals. P %: Parasitic prevalence. **Mesostigmata*, ***M. ovinus*.

Table I. – Ectoparasites distribution among the different host species.

four animals (3.8 %) others such as *Mesostigmata* and *Melophagus ovinus* (Linnaeus, 1761).

Ticks: we found 593 ticks included on 10 species (Table II). The hedgehog, fox and badger showed the greater ixodidae variety, six and four species each other, respectively. Two or more ticks species were observed on 24 specimens (40 %) of the mixed infestation. The most frequent association was *Ixodes ricinus* (Linnaeus, 1746) and *Ixodes hexagonus* (Leach, 1815) on eight samples, followed by *Haemaphysalis punctata* (Canestrini & Fanzago, 1877) and *Dermacentor reticulatus* (Fabricius, 1794).

I. ricinus was the most prevalent being found on 30 samples from 10 hosts. *H. punctata* was found on 16 samples from seven hosts and *I. hexagonus* on 24 samples from seven hosts, were others usual ticks species. *D. reticulatus* was mainly a fox and wolf ectoparasite, being observed on 36.8 % and 33 % of the parasited animals, meanwhile others ticks were scarcely detected in the zone. The roe deer showed high parasitic intensity, 47 ticks/animal.

Fleas: we found 348 fleas belonging to 14 species (Table III). Fox, wild cat, and stone marten showed the greatest variety of fleas, four species each one. *Paraceras melis melis* (Walker, 1856) had the wider host range, four species, meanwhile *Pulex irritans* (Linnaeus, 1758) was the most prevalent since it appeared on 13 samples, but only on three hosts, although was high, such on the fox, 61.5 % and the wolf, 100 %. The fox was the only *Ctenocephalides canis* (Curtis, 1825) host (53.8 %). *Ceratophyllus (Monopsyllus) sciurorum sciurorum* (Schrank, 1803) was observed on four hosts, two of them primary hosts and two accidental. *Chaetopsylla trichosa* (Kohaut, 1903) was found on 33.3 % of the badgers, being rare in other carnivora. *Archaeopsylla erinacei erinacei* (Bouché, 1835) was more prevalent than subspecies *maura*, 66.6 % and 16.6 % respectively. The first showed a notorious parasitic intensity (13.8 fleas/host) and was the most common flea species in the study.

Two or more fleas species were observed on 13 samples, 26 % mixed infestations and the usual association was *C. canis* and *P. irritans*, four samples. *Ctenocephalides felis felis* (Bouché, 1835) showed the higher parasitic intensity, 36 fleas/stone marten. Other fleas were scarcely collected, many of them in accidental hosts.

Chewing-lice: we also found 1,550 lice belonging to two species: *Trichodectes melis* (Fabricius, 1805), *Trichodectes canis* (De Géer, 1778). They were observed on the badger and on the wolf showing a parasitic intensity of 300 and 650 lice per animal, respectively. Others: the hippoboscids *Melophagus ovinus* was incidentally collected on the roe deer, as well as *Mesostigmata* (unidentified) on two micromammals and on the polecat.

DISCUSSION

TICKS

Roe deer is in our area a suitable maintenance host of *Ixodes ricinus*, showed high intensity and parasitic prevalence, as well as several specimens. This tick was present in all study area, increasingly in the northern sector (600-1,200 mm rainfalls), and in a similar way as in European countries (Gilot *et al.*, 1994; Aubert, 1975), and meanwhile is scarcely in southern sector, as in different submediterranean regions in Spain (Encinas, 1986; Estrada-Peña *et al.*, 1992).

Ixodes hexagonus was a new record in the study area, being always associated to the hedgehog, as well as to little and middle carnivora and his burrows (Travassos, 1994). The parasitic prevalence found in foxes was lower than reported by Aubert (1975) in France, but higher than mentioned by Encinas (1986) in Salamanca, where he reported the change of genus *Rhipicephalus* Koch in the warm period for genus *Ixodes* Latreille in the cool period. We found autumn-winter association between *I. hexagonus* and *D. reticulatus* and the replacement of the last by *I. ricinus* along spring. *Ixodes canisuga* (Johnston, 1849) shows preference for other environments, as previously reported on fox in the Spanish mediterranean zone (Encinas, 1986; Estrada-Peña *et al.*, 1992), but it was a surprising new record on the badger, despite being a frequent species in Europe in this host (Hillyard, 1996; Aubert, 1975).

Ixodes ventralloi (Gil Collado, 1936) is a tick of the sub-humid areas of Spain, despite Encinas (1986) does not find it in Salamanca. We collected it restricted to the hedgehog, in a submediterranean environment.

Ixodes trianguliceps (Birula, 1895) is found scarcely in Spain, only in the Eurosiberian zone (Gilot *et al.*, 1976; Estrada-Peña, 1995). A nymph was collected on a squirrel, host not previously recorded in Spain, but usual in other european countries (Hillyard, 1996).

Haemaphysalis punctata colonizes mediterranean areas, but humid zones in the northern Burgos were more suitable (Domínguez, 1999). Adults were found in the hosts from the end of the summer until spring, together with *I. ricinus*, especially in non carnivora mammals (Estrada-Peña, 1992).

Dermacentor reticulatus occurs in Cantabric bushy environments (Cordero *et al.*, 1994), where it was the most active and prevalent species in the Burgos humid zone during the cool months (Domínguez, 1999). It showed affinity for the *Canidae* (wolf and fox) in our area, but other reports in Spain (Estrada-Peña *et al.*, 1992) pointed out that it was not collected in foxes, being considered Centraleuropean species (Encinas, 1986). In

Host (T)	N	<i>Ixodes ricinus</i>			<i>Ixodes hexagonus</i>			<i>Ixodes canisuga</i>			<i>Ixodes ventalloi</i>			<i>Ixodes trianguliceps</i>			<i>Haemaphysalis punctata</i>			<i>Dermacentor reticulatus</i>			<i>Dermacentor marginatus</i>			<i>Rhipicephalus turanicus</i>			<i>Rhipicephalus pusillus</i>		
		I	A	n	I	A	n	I	A	n	I	A	n	I	A	n	I	A	n	I	A	n	I	A	n	I	A	n			
<i>Canis lupus</i> (6)	3		6	1															1	1								18	1		
<i>Vulpes vulpes</i> (26)	19	12	11	9	72	13	8									3	1		55	7											
<i>Felis silvestris</i> (6)	4		1	1	8		2									2	2														
<i>Meles meles</i> (7)	5		1	1	5		2	1	1	2						1	1														
<i>Mustela foina</i> (6)	2	1	1	2	2	2	2									1	1														
<i>Mustela putorius</i> (7)	1				1		1																								
<i>Mustela erminea</i> (2)	1				1		1																								
<i>Genetta genetta</i> (1)	1	26		1																											
<i>Capreolus capreo</i> (4)	4	68	120	4																											
<i>Lepus europaeus</i> (4)	4	9	1	2												24	2	3													
<i>Sciurus vulgaris</i> (7)	4	14		3									1	1		2	2				1	1									
<i>Erinaceus europ</i> (22)	15	52	4	6	17	5	8				3	2				9	4	6			4	2		7	1						
Total hosts (98)	103	182	145	30	106	20	24	1	1	2	3	2	1	1		42	6	16		56	8	5	3		7	1		18	1		

(T): Total hosts. N: Number of parasited hosts (any tick). n: Number of parasited hosts (each tick species). I: Immature. A: Adult (each tick species).

Table II. – Ticks distribution among the different host species.

Host (T)	N	<i>Pa. m. melis</i>		<i>Pu. irritans</i>		<i>Ct. f. felis</i>		<i>Ct. canis</i>		<i>Ce. (M.) s. sciurorum</i>		<i>Cb. trichosa</i>		<i>Cb. matina</i>		<i>Ar. e. erinacei</i>		<i>Ar. e. maura</i>		<i>No. fasciatus</i>		<i>Ctenophthal mus spp.</i>		<i>Sp. cuniculi</i>		<i>Pe. S. spectabilis</i>		<i>Pa. minor</i>	
		A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n
<i>Canis lupus</i> (6)	4	1	1	7	4																								
<i>Vulpes vulpes</i> (26)	13	4	2	22	8	4	2	27	7			1	1																
<i>Felis silvestris</i> (6)	4					1	1			1	1										1	1	6	1	1	1			
<i>Meles meles</i> (7)	6	6	5									4	2																
<i>Mustela foina</i> (6)	5	3	1			36	1					1	1	2	1					1	1								
<i>Martes martes</i> (1)	1									1	1																		
<i>Mustela putorius</i> (7)	1	1	1																										
<i>Sciurus vulgaris</i> (7)	5									29	5																		
<i>Glis glis</i> (2)	2									2	2																		
<i>Microtus arvalis</i> (2)	2																				1	1						3	1
<i>Erinaceus europ.</i> (22)	12			2	1											111	8	2	2		1	1							
Total host (93)	54	15	10	31	13	41	4	27	7	33	9	6	4	2	1	111	8	2	2	1	1	3	3	6	1	1	1	3	1

(T): Total hosts. N: Number of parasited hosts (any flea). n: Number of parasited hosts (each flea species). A: Adult (each flea species).

Table III. – Flea distribution among the different host species.

the UK, Harris & Thompson (1978) has neither recorded this species on the carnivora.

Dermacentor marginatus (Sulzer, 1776) is more or less a xerophilic species, despite bearing rainfalls ranges until 1,000 mm in Portugal (Travassos, 1994), as in our study area. We recovered two nymphs on hedgehogs and on red squirrel during the summer, when the immatures were active, according with Estrada-Peña *et al.* (1992).

Rhipicephalus turanicus (Pomeranzen, 1940) is rare in our humid areas (Travassos, 1994), and the hedgehog is a frequent host for immature stages in the non-African environments (Walker *et al.*, 2000) and new record in our province.

Rhipicephalus pusillus (Gil Collado, 1938) parasited the rabbit, *Oryctolagus cuniculus* (Linnaeus, 1758) and his predators, the fox, wolf and others (Cordero *et al.*, 1994). A wolf record from the South of the province was included in order to compare South and North populations that on our findings basis, were endophilic and exophilic species (*I. ricinus* and *D. reticulatus*), respectively in each area.

FLEAS

Paraceras m. melis was collected on carnivora such as badger, his main host (Gil Collado, 1949; Sanchez *et al.* 1973), stone marten, polecat and wolf, due to the use of badgers burrows or due to predation by other carnivora like the wolf. Similar to our observations, some European reports point to the fox as a suitable host (Smit, 1957; Beaucournu & Launay, 1990).

Pulex irritans has the wider range hosts, however, many authors (Smit, 1957; Beaucournu & Launay, 1990) describe this species as characteristic of dog and other carnivora, some confirmed in our study, being the most prevalent flea on the fox and on the wolf (only slightly studied previously). Gracia *et al.* (2000) reported high prevalence in kennels and among people working on them, both being suitable hosts (Martinez *et al.*, 1978; Cordero *et al.*, 1994). This species was found in all the area, being more frequently at the end of the summer (Beaucournu & Launay, 1990).

Ctenocephalides f. felis is widely distributed all the year round in domestic and synanthropic carnivora causing human diseases and nuisances (Beaucournu & Launay, 1990). Nevertheless, we only observed intensive parasitization on a stone marten, and with lower frequencies in fox or wild cat, source of infestation for other animals and man.

Ctenocephalides canis is the main dog and fox flea (Smit, 1957). We considered the last one as the only host in the area. Our results agree with those described by Beaucournu & Launay (1990), suggesting that in its distribution areas this flea is not as usual as expected among some vertebrates.

Ceratophyllus (M.) s. sciurorum occurs in northern Iberian Peninsula (Beaucournu & Launay, 1990), as well as his main hosts, red squirrel and fat dormouse. Our findings bear out the usual presence of the parasite in both hosts. Meanwhile the recovering in wild cat and pine marten, recorded by Smit (1957) and Beaucournu & Launay (1990), might be ascribed to the predation of this carnivora.

Chaetopsylla trichosa was reported for the first time in Spain on the badger by Gil Collado (1949) as *C. trichosa hispanica*. We found the flea on stone marten and fox, as secondary hosts. Badger is the main host, as we previously observed in South Burgos (unpublished data). Nevertheless, we agree with Beaucournu & Launay (1990) that this species is not abundant on the hosts.

Chaetopsylla matina (Jordan, 1925) was found on the stone marten, in the Bocos Port at 900 m height. As far as we know, it is a new record for Spain, and Beaucournu & Launay (1990) report this species in the Pyrenees as a specimen of discontinuous distribution, unfrequent and of unknown ecology.

Archaeopsylla erinacei has two subspecies in the Mediterranean area, but only one, *Archaeopsylla erinacei maura* (Jordan & Rothschild, 1912), in the Iberian Peninsula (Smit, 1957; Gil Collado, 1976). We reported for the first time the subspecies *erinacei* in Spain, following the keys of Beaucournu & Launay (1990). This subspecies was the more frequent, both as prevalence and as abundance, than subspecies *maura*, which was only found in two southern places. We must emphasize the notorious intensity of infestation by subspecies *erinacei*, as reported in the UK by Smit (1957). *Nosopsyllus fasciatus* (Bosc D'Antic, 1801) was collected on a stone marten, probably being infected after predation of a wild or domestic rodent (*Rattus* spp.).

Others fleas were scarcely found, such as genus *Ctenophthalmus* Kolenati a micromammals parasite. We only collected one specimen on a usual host, the mole (Beaucournu & Launay, 1990). Other findings were in accidental hosts, one on a hedgehog and one on a wild cat, as predators.

Spilopsyllus cuniculi (Dale, 1878) distribution in Spain is closely related to that of its preferred host, the rabbit *Oryctolagus cuniculus* (Linnaeus, 1758). It was found on an accidental host, the wild cat, from the southern limit of the study area, where there are rabbit populations. Beaucournu & Launay (1990) also reported the role of some carnivora as accidental hosts, as well as described for *Peromyscopsylla spectabilis spectabilis* (Rothschild, 1912), that we found on a wild cat. *Palaeopsylla minor* (Dale, 1876) is present in the Spanish and European grasslands (Smit, 1957; Cordero *et al.*, 1994), and on his inhabitants, the moles, where we recovered the parasites.

MALLOPHAGA

Respect to the Mallophaga, we reported *Trichodectes melis* for the first time in the Burgos province on half (42,8 %) of the investigated badgers. Two specimens showed a high infestation intensity, focused on head and neck. *Trichodectes canis*, found in a young wolf and previously cited on dogs (Martin, 1977), is a new record in the Iberian Peninsula, showing an intensive parasitisation and similar body distribution than badger.

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REFERENCES

- AUBERT M.F.A. Contribution à l'étude du parasitisme du renard (*Vulpes vulpes*) par les Ixodidae (Acarina) dans le Nord-Est de la France. *Acarologia*, 1975, XVII (3), 452-479.
- BEAUCOURNU J.C., GILOT B. & VERICAD J.R. Contribution à l'étude des Siphonaptères du Sud-Est de la Péninsule Ibérique. *Eos*, 1973, 49, 49-78.
- BEAUCOURNU J.C. & LAUNAY H. Les puces de France et du bassin méditerranéen occidental. Faune de France 76, Paris, 1990.
- CORDERO DEL CAMPILLO M., CASTAÑON L., & REGUERA A. Índice-catalogo de zooparásitos Ibéricos. 2ª ed. Secretariado de Publicaciones, León, 1994.
- DOMÍNGUEZ G. Las garrapatas (Ixodidae) en el NW. de Burgos. Aspectos de su ecología e interés sanitario. *Medicina Veterinaria* 1999, 16 (11), 525-535.
- ENCINAS A. Ticks of the province of Salamanca (Central/NW Spain). *Annales de Parasitologie Humaine et Comparée*, 1986, 61, 95-107.
- ESTRADA-PEÑA A., OSACAR J.J., GORTAZAR C., CALVETE C. & LUCIENTES J. An account of the ticks of the northeastern of Spain. *Annales de Parasitologie Humaine et Comparée*, 1992, 67, 42-49.
- ESTRADA-PEÑA A., OTEO J.A., ESTRADA-PEÑA R., GORTAZAR C., OSACAR J.J., MORENO J.A. & CASTELLA J. *Borrelia burgdorferi* sensu lato in ticks (Acari: Ixodidae) from two different foci in Spain. *Experimental and Applied Acarology*, 1995, 19, 173-180.
- ESTRADA-PEÑA A. Catálogo geográfico de las garrapatas en la Península Ibérica. Mallinckrodt Veterinary, Madrid, 1995.
- GIL COLLADO J. Pulgas españolas parásitas de roedores, *Revista Iberica de Parasitologia*, 1949, IX, 213-258.
- GIL COLLADO J. & RIVAS L.I. Nuevas citas de sifonápteros parásitos de mamíferos en España. *Acta Vertebrata*, 1976, 3 (1), 79-88.
- GILOT B., PAUTOU G., GOSALBEZ J. & MONCADA E. Contribution à l'étude des Ixodidae (Acarina, Ixodoidea) des Monts Cantabriques (Espagne). *Annales de Parasitologie Humaine et Comparée*, 1976, 51 (2), 241-254.
- GILOT B., BONNEFILLE M., DEGEILH B., BEAUCOURNU J.C., PICHOT J. & GUIGUEN C. The colonization of forested areas by *Ixodes ricinus* in France: use of the roedeer, *Capreolus capreolus* as a biological marker. *Parasite*, 1994, 1, 81-85.
- GRACIA M.J., LUCIENTES J.A., CASTILLO M.A., LA TORRE E., ZARATE J. & ARBEA I. *Pulex irritans* infestation in dogs. *Veterinary Record*, 2000, Dec, 23-30.
- HARRIS S. & THOMPSON G.B. Populations of the ticks *Ixodes (Pholeoixodes) hexagonus* and *Ixodes (Pholeoixodes) canisuga* infesting suburban foxes (*Vulpes vulpes*). *Journal of Zoology of London*, 1978, 186, 83-93.
- HILLYARD P.D. Ticks of North-West Europe. British Fauna, nº 52. Barnes & Crothers, London, 1996.
- HOPKINS G.H.E. & ROTHSCHILD M. An illustrated Catalogue of the Rothschild collection of fleas (Siphonaptera) in the British Museum (Natural History). Vol. I, Tungidae and Pulicidae. British Museum, London, 1953.
- HUTSON A.M. Keds, Flat-Flies and Bat-flies. Handbooks for the identification of British insects. Vol. 10, Part 7. Royal of Entomological Society, London, 1984.
- MANILLA G. Fauna d'Italia Acari Ixodida. Ed. Calderini, Bologna, 1998.
- MARTÍN M.P. Estudio de *Trichodectidae* (Mallophaga: Insecta) parásitos de mamíferos en España. *Revista Iberica de Parasitologia* 1977, 37, 1-25.
- MARTÍNEZ F., HERNÁNDEZ S., CALERO R. & MORENO T. Contribución al conocimiento de los parásitos del zorro (*Vulpes vulpes*). *Revista Iberica de Parasitologia*, 1978, 38, 208-211.
- ROMAN J., ROMAN L., ANSOLA L.M., PALMA C. & VENTOSA R. Atlas de las aves nidificantes de la provincia de Burgos. Ed. CACO, Burgos, 1996.
- SANCHEZ C. & VERICAD J.R. Ectoparásitos de mamíferos y aves montañeses del alto Aragón. *Revista Iberica de Parasitologia*, 1973, 33, 29-38.
- SCHÖFFEL I., SCHEIN E., WITTSTADT U. & HENTSCHKE J. Zur Parasitenfauna des Rotfuchses in Berlin (West). *Berliner und Münchener Tierärztliche*, 1991, 104, 153-157.
- SMIT F.G.A.M. Siphonaptera. Handbooks for the identification of British insects, Vol. 1, Part. 16. Royal of Entomological Society, London, 1957.
- TRAVASSOS SANTOS DIAS J.A. As carracas (Acarina-Ixodoidea) da Península Ibérica. Ministerio do Planeamento e Admon. Do Território, Lisboa, 1994.
- WALKER J.B., KEIRANS J.E. & HORAK I.G. The genus *Rhipicephalus* (Acari: Ixodidae). A guide to the brown ticks of the world, 1st ed., New York, 2000.

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