ANNALES DE PARASITOLOGIE
HUMAINE ET COMPARÉE

Tome 59 1984 N° 3

© *Masson, Paris, 1984.*

Ann. Parasitol. Hum. Comp.,
1984, t. 59, n° 3, pp. 219-226.

MÉMOIRES ORIGINAUX

OCCURRENCE OF *LEUCOCYTOZOON* AND *HAEMOPROTEUS* (Apicomplexa, Haemosporina) in Falconiformes and Strigiformes of Italy

L. SACCHI and C. PRIGIONI*

SUMMARY. Blood smears from Falconiformes (91 birds of 10 species) and Strigiformes (23 birds of 5 species) captured in Italy, were examined for haematozoa. *Leucocytozoon* were found in *Falco tinnuculus*, *Buteo buteo*, *Circus cyaneus*, *Circus pygargus*, *Accipiter nisus* from Falconiformes and in *Strix aluco*, from Strigiformes. *Haemoproteus* were found in *Falco tinnuculus* and *Strix aluco ;* this latter species harbored mixed infections *Leucocytozoon-Haemoproteus*. Prevalences were 20.80% in Falconiformes and 21.74% in Strigiformes.

Présence de *Leucocytozoon* et *Haemoproteus* (Apicomplexa, Haemosporina) chez des Falconiformes et Strigiformes d'Italie.

RÉSUMÉ. Des frottis de sang de Falconiformes (91 individus de 10 espèces) et de Strigiformes (23 exemplaires de 5 espèces) capturés en diverses localités italiennes ont été examinés. On y a rencontré la présence de *Leucocytozoon* dans *Falco tinnuculus*, *Buteo buteo*, *Circus cyaneus*, *Circus pygargus*, *Accipiter nisus* parmi les Falconiformes et chez *Strix aluco* parmi les Strigiformes. *Haemoproteus* a été observé chez *Falco tinnuculus* et chez *Strix aluco* ; dans ce dernier, une infection de *Haemoproteus-Leucocytozoon* a été observée. Les pourcentages d'infections observés ont été respectivement de 20.80% pour les Falconiformes et de 21.74% pour les Strigiformes.

Introduction

Studies carried out on haematozoa of birds since the beginning of this century, have gathered wide information on the epidemiology and biology of these parasites. These studies have, in some cases, permitted to know in depth the complex life-cycles of some blood parasites, either in the vertebrate host or in the insect vector.

* *Dipartimento di Biologia Animale, Piazza Botta 9, 27100 Pavia, Italy.*
Accepté le 20 juillet 1983.

Article available at http://www.parasite-journal.org or https://doi.org/10.1051/parasite/1984593219

The most complete information has been obtained from species of birds belonging to orders Anseriformes, Passeriformes and Galliformes because the capture and care in captivity of a large number of such birds is relatively easy. However there is less information on Falconiformes and Strigiformes which are less numerous and whose capture is difficult.

This is valid especially if one excludes, as we did, the use of haematic samples originating from animals kept in captivity. Presently, the geographic distribution of the haematozoa of birds of prey is known in the large continental areas : South and Central America (White *et al.* 1978) ; North America (Greiner *et al.* 1975), Southeast Asia (McClure *et al.* 1978). East Africa (Peirce and Cooper 1977), Western Europe (Peirce 1981), and U.S.S.R. (Yakunin, 1972). In Italy, besides the pioneer works of Franchini (1923, 1924) and the more recent ones of Corradetti *et al.* (1941) and Corradetti and Scanga (1963), nothing more has been done in this field. We present here some records of blood parasites of raptors found in Italy. 91 Falconiformes (10 species) and 23 Strigiformes (5 species) *(Table I)*, were examined, captured in field. Apart from the purely epidemiological aspect, this work describes some host-parasite associations hitherto not observed in Italy.

TABLE I. — Haematozoa from Italian Falconiformes and Strigiformes. (L = Leucocytozoon ; H = Haemoproteus)

Common name	Species	Number examined	Number positive	L	H	L+H
FALCONIFORMES						
Osprey	*Pandion haliaetus*	1	—	—	—	—
Kestrel	*Falco tinnuculus*	20	6	1	5	—
Buzzard	*Buteo buteo*	39	9	9	—	—
Montagu's Harrier	*Circus pygargus*	1	1	1	—	—
Hen Harrier	*Circus cyaneus*	2	1	1	—	—
Sparrow Hawk	*Accipiter nisus*	7	3	3	—	—
Marsh Harrier	*Circus aeruginosus*	7	—	—	—	—
Goshawk	*Accipiter gentilis*	3	—	—	—	—
Spotted Eagle	*Aquila clanga*	1	—	—	—	—
Honey Buzzard	*Pernis apivorus*	10	—	—	—	—
STRIGIFORMES						
Barn Owl	*Tyto alba*	5	—	—	—	—
Tawny Owl	*Strix aluco*	7	5	2	1	2
Little Owl	*Atene noctua*	4	—	—	—	—
Short-eared Owl	*Asio flammeus*	1	—	—	—	—
Long-eared Owl	*Asio otus*	6	—	—	—	—
Total	15 Species	114	25	18	6	2

Materials and methods

Blood films were obtained in 1981 and 1982, most in north and some in middle Italy, from various localities considerably distant from each other. Smears were air-dried and fixed in 100% methanol, and stained in Giemsa's solution (ph 7.4).

Observations and photographs were made using a Leitz Orthoplan microscope with Orthomat. Measurements of the gametocytes were made with Visopan Riechart microscope, following criteria proposed by Bennett and Campbell (1975). The nomenclature follows Woous (1972).

Results

Genus Leucocytozoon

Buzzard

Of the 39 Buzzards *(Buteo buteo)* examined, 9 (20.08%) were infected. In two cases we observed, besides oval and elongate gametocytes already described by Sacchi and Prigioni (1982), round gametocytes *(fig. 1)*. The latter were found in few cases in the Falconiformes ; Franchini (1923) described round microgametocytes in *Circus macrourus* and in 1924 observed round or oval shaped macrogametocytes in *Circus aeruginosus*. Wingstrand (1947) described in *L. mathisi*, both round and elongate gametocytes. The round shaped gametocytes were inserted in the redescription of *Leucocytozoon toddi* proposed by Greiner and Kocan (1977). These Authors took as model the round gametocytes of *L. bacelari*, described by Tendeiro (1947) in *Kaupifalco monogrammicus*. The round gametocytes observed by us present the following characteristics : round macrogametocytes 13.6 to 15.2 μm, by 10.4 to 11.6 μm, cytoplasm dark blue with small vacuoles, nucleus variable in position irregular from staining red colour ; round microgametocytes 11.2 to 13.6 μm, by 12 to 14.4 μm, cytoplasm pale violet irregularly stained with diffuse pinkish nucleus. Infected host cells containing round macrogametocytes 17.6 to 19.2 μm, by 12.8 to 13.6 μm, without cytoplasmic horns, nucleus staining deep red, flattened and lateral to parasite ; when containing microgametocytes 13.6 to 15.2 μm, by 10.4 to 12.8 μm.

Hen and Montagu's Harriers.

One Montagu's Harrier *(Circus pygargus)* captured at Mestre (Venice) on the 18.11.81, and one Hen Harrier *(Circus cyaneus)* of the two captured at Aosta (20.11.81) were infected with *Leucocytozoon*. No record in *Circus pygargus* is known to us, while a case is known in *Circus cyaneus* from North America (Stabler and Holt, 1965).

In Italy, Franchini (1923) described *Leucocytozoon laverani* (*L. Franchini ;* França 1927) in *Circus macrourus*.

That gametocytes observed by us present only oval and elongate forms. The shape of the gametocytes is similar in the two host species. The macrogametocytes *(fig. 2)* have dark blue cytoplasm with small vacuoles, the nucleus is oval shaped and long, reddish colour, variable in position. The host cells are oval or elongate with two large cytoplasmic wings pale pink in colour, the nucleus appears lateral and flattened. The microgametocytes *(fig. 3)* have a pink-cytoplasm with chromato-

philic granulation. The host cell is elongate with a lateral and flattened nucleus, with two wide light pink polar expansions. The dimensions of the gametocytes and of the parasitic cells are presented in *table II*.

Kestrel

We know a description of *Leucocytozoon* in Kestrel *(Falco tinnuculus)* by Böing (1925) in Germany, and a record by Yakunin (1972) in Kasakhstan (U.S.S.R.). Of the 20 of Kestrel examined by us, only one, (captured in the province of Parma on 26.11.81) was infected with *Leucocytozoon*. This is the first record for Italy, therefore we consider it important to report the following data : macrogametocytes *(fig. 4)* oval or elongate, blue cytoplasm with numerous small vacuoles, the oval nucleus with nucleolus hardly perceptible. The nucleus of the host cell, usually lateral, in some cases presents an oval shape similar to the nucleus of an erythrocytes. The host cell is spindle shaped with cytoplasmic polars wings, light pink in colour. Microgametocytes *(fig. 5)* oval and elongate, cytoplasm dark pink colour, with chromatic zones of a more intense colouring, the nucleus is diffuse.

The nucleus of the host cell is lateral and flattened. The host cell, oval or elongate, presents two wide cytoplasmic expansions of deep pink colour. The dimensions of the parasite and of the host cell are reported in *Table II*.

Sparrow Hawks

L. mathisi was found in 3 Sparrow Hawks *(Accipiter nisus)*, 2 of which came from Torino, (27.1.82) and 1 from Parma (5.10.82). Prior documentation in Italy of such has been given by Franchini (1924). The gametocytes were both round and elongate *(fig. 6)*.

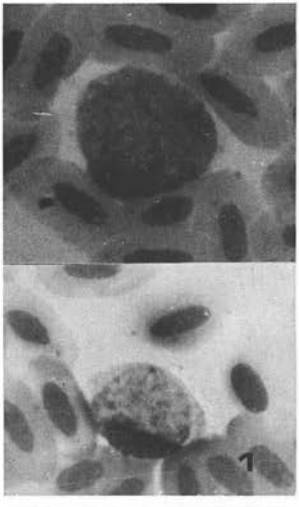
Tawny Owl

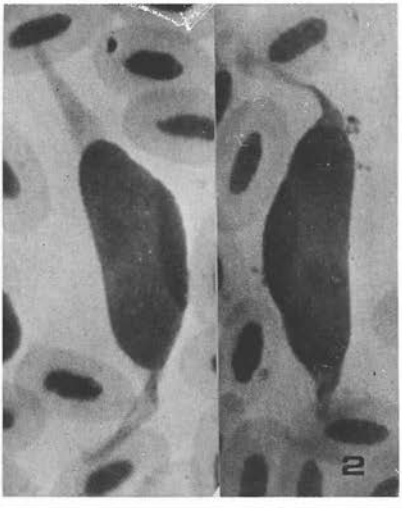
Of 7 Tawny Owls *(Strix aluco)* captured at Livorno (13.2.82), Pavia (27.5.82), Parma (23.4.82) and Modena (27.4.82), four birds were infected with *L. ziemanni*. This is the first documented case in Italy ; the characteristics of the parasite are those already well known in literature.

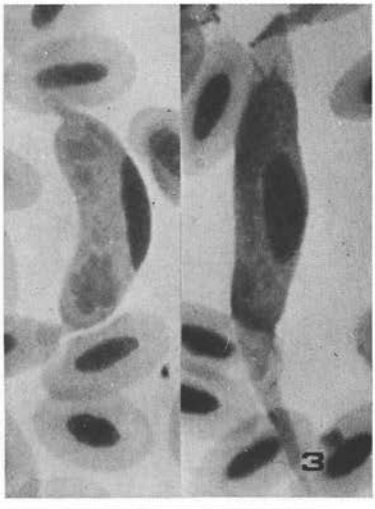
PLATE

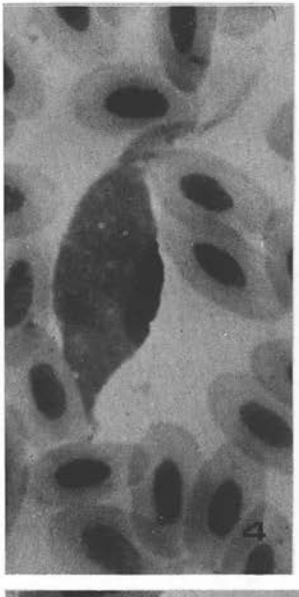
FIG. 1-8. — Blood films of various species of Raptors infected with Leucocytozoon and Haemoproteus.

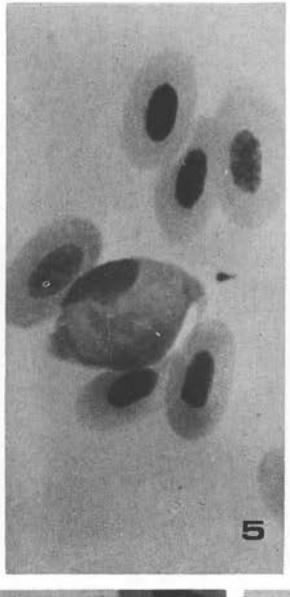
(1) Macrogametocyte (upper) and microgametocyte "round" from *Buteo buteo*. (2) Macrogametocyte from *Circus pygargus* (left) and from *C. cyaneus* (right). (3) Microgametocyte from *Circus pygargus* (left) and from *C. cyaneus* (4) Macrogametocyte and (5) microgametocyte from *Falco tinnunculus*. (6) Macro- (left) and microgametocyte (right) from *Accipiter nisus*. (7) *Haemoproteus tinnunculi :* macro- (left) and microgametocyte (right). (8) *Haemoproteus aluci:* macro- (left) and microgametocyte (right) and Macrogametocyte "round" of *Leucocytozoon ziemanni*.

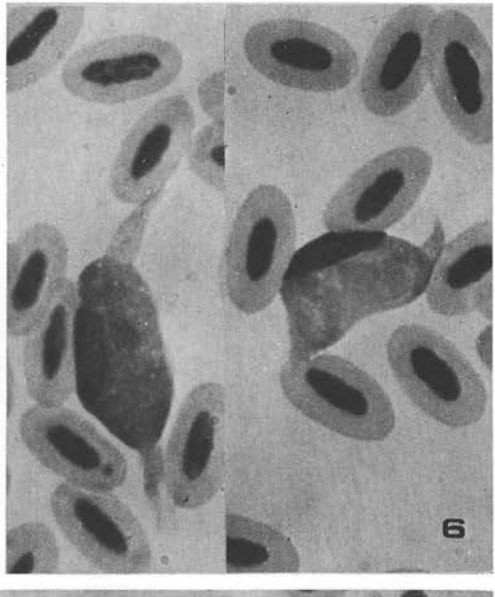

1


2


3


4


5


6


7


8

TABLE II. — Dimensions of the erythrocytes and of the gametocytes of *Leucocytozoon* in some species of Falconiformes. The data expressed in μm, with standard deviation in parenthesis, have been obtained from 10 gametocytes and 10 erythrocytes not infected for every single species of vertebrate host.

	Hen Harrier			Montagu's Harrier			Kestrel		
	Lenght	Width	Area	Lenght	Width	Area	Lenght	Width	Area
Unifected erythrocyte	13.2 (0.6)	6.4 (0.1)	66.3 (3.3)	13.3 (0.6)	7.1 (0.5)	72.7 (5.2)	12.9 (0.5)	6.7 (0.3)	65.7 (4.7)
Unifected erythrocyte nucleus	6.1 (0.2)	2.2 (0.2)	10.5 (1.0)	6.3 (0.6)	2.0 (0.2)	10.2 (0.7)	5.6 (0.2)	2.2 (0.2)	10.3 (1.0)
Round macrogametocyte	—	—	—	—	—	—	—	—	—
Host cell nucleus	—	—	—	—	—	—	—	—	—
Oval microgametocyte	20.3 (1.8)	9.7 (0.7)	151.2 (10.6)	20.9 (1.6)	10.3 (1.1)	161.9 (12.7)	17.5 (2.1)	11.2 (1.3)	154.0 (19.4)
Host cell nucleus	10.6 (1.2)	3.0 (0.6)	23.8 (5.1)	11.8 (0.7)	2.6 (0.9)	24.9 (7.2)	9.5 (2.4)	3.6 (1.2)	21.7 (9.1)
Elongate macrogametocytes	23.3 (1.3)	7.4 (0.6)	135.8 (11.5)	27.6 (1.4)	6.0 (0.5)	124.9 (10.6)	21.4 (2.4)	6.9 (1.2)	120.4 (19.4)
Host cell nucleus	10.3 (3.5)	3.3 (0.4)	27.0 (4.3)	10.2 (0.9)	2.9 (0.3)	20.3 (3.1)	7.9 (2.8)	2.4 (1.0)	15.4 (9.3)
Oval microgametocyte	—	—	—	—	—	—	—	—	—
Host cell nucleus	—	—	—	—	—	—	—	—	—
Round microgametocyte	—	—	—	—	—	—	14.9 (1.9)	9.5 (1.2)	106.7 (23.6)
Host cell nucleus	—	—	—	—	—	—	8.5 (2.2)	4.1 (0.7)	25.9 (10.6)
Elongate microgametocyte	21.8 (1.8)	8.4 (0.7)	136.5 (11.0)	22.1 (1.2)	8.7 (1.5)	142.8 (20.8)	20.5 (4.5)	7.9 (3.3)	104.2 (25.4)
Host cell nucleus	11.0 (1.4)	3.0 (0.5)	23.7 (4.3)	11.0 (0.8)	3.0 (0.3)	22.7 (2.8)	8.7 (1.9)	3.0 (0.4)	20.5 (6.0)

Genus Haemoproteus

Kestrel

In Italy *H. tinnunculi* was found in Kestrel by Grassi and Feletti (1890), Franchini (1923) and Corradetti and Scanga (1963). We observed the same parasit in 5 examples captured in the provinces of Parma (6.11.81, 30.11.81, 1.7.82) and Pavia (10.3.82) and in Malta (11.2.82) *(fig. 7)*.

Tawny Owl

We observed *H. aluci*, documented by Celli and Sanfelice (1891) in Italy, in three Tawny Owls captured at Livorno (13.2.82) and at Parma (23.4.82, 5.5.82).

In two cases *H. aluci* was present in concomitant infection with *L. ziemanni (fig. 8)*.

Comments

The percentage of infected animals observed by us (24 out of 114, i.e. 21.05%) is similiar to that observed by Peirce and Copper (1977) in Birds of Prey of Great Britain (21.43% ; i.e. 15 infected out of 70). In accordance with our data, these authors found that the infection involved almost exclusively Haematozoa belonging to the genera *Leucocytozoon* and *Haemoproteus*.

Infections were observed all the year round. This renders it extremely difficult to associate the infection of the hosts with the presence of unknown insects vectors.

The presence of the infection throughout nearly all months of the year makes it rather problematic to distinguish the new infections from those chronic ones.

Some systematic problems arise for the classification of *Leucocytozoon* found by us in *Falco tinnuculus, Circus cyaneus* and *C. pygargus*. On the basis of both morphological and biometrical characteristics observed, these parasites could be considered as interspecific variants of *L. toddi*, which, according to Greiner and Kocan (1977) represent the only parasite species present in the Falconiformes. This species is probably the same observed in *Buteo buteo* where we found all morphotypes, (round, oval and elongate) described in literature.

REFERENCES

BENNETT G. F., CAMPBELL A. G. : Avian Leucocytozoidae. I. Morphometric variation in three species of *Leucocytozoon* and some taxonomic implication. *Can. J. Zool.*, 1975, *53*, 800-812.

BÖING W. : Untersuchungen uber Blutschmarotzer bei einheimischen Vogelwild. *Zentbl. Bakt. Parasitkunde Abt.* I, 1925, *95*, 312-327.

CELLI A., SANFELICE F. : Sui parassiti del globulo rosso nello uomo e negli animali. *Annali Instituto d'Igiene sperimentale della R. Università* di Roma, 1891, *1*, 33-63.

CORRADETTI A., CAVALLUCCI S., CRESCENZI R. : Incidenza degli ematozoi delle civette nella Campagna Romana all'inizio dell'autunno. *Riv. Parassit.*, 1941, *5*, 251-252.

CORRADETTI A., SCANGA M. : Segnalazione in Europa di *Plasmodium (Giovannolaia) polare* Manwell, 1934 nel nuovo ospite *Falco tinnuculus* e studi sulla biologia di questo plasmodio. *Parassitologia*, 1963, *5*, 61-72.

FRANÇA C. : Notes parasitologiques. *Jorn. Sci. Math. Phys. Nat.* 1927, *5*, 15-24.
FRANCHINI G. : Hematozoaires de quelques oiseaux d'Italie. *Bull. Soc. Pathol. Exot.*, 1923, *16*, 118-125.
FRANCHINI G. : Observations sur les hématozoaires des oiseaux d'Italie. *Ann. Inst. Pasteur*, Paris, 1924, *38*.
GRASSI B., FELETTI R. : Parassiti malarici negli uccelli. *Boll. Sed. Accad. Gioenia Sci. Nat.*, Catania, 1890, *13*, 3-6.
GREINER E. C., BENNETT G. F., WHITE E. M., COOMBS R. F. : Distribution of the avian haematozoa of North America. *Can. J. Zool.*, 1975, *53*, 1762-1787.
GREINER E. C., KOCAN A. A. : *Leucocytozoon* (Haemosporida : Leucocytozoidae) of the Falconiformes. *Can. J. Zool.*, 1977, *55*, 761-770.
MCCLURE H. E., POONSWAD P., GREINER E. C., LAIRD M. : *Haematozoa* in Birds of Eastern and Southern Asia. *Memorial University of Newfoundland*, St John's, Newfoundland, 1978.
PEIRCE M. A., COOPER J. E. : Haematozoa of birds of prey in Great Britain. *Vet. Rec.*, 1977, *100*, 493.
PEIRCE M. A. : Distribution and host-parasite check-list of the haematozoa of birds in Western Europe. *J. Nat. Hist.*, 1981, *15*, 419-458.
SACCHI L., PRIGIONI C. : A *Leucocytozoon* of Buzzard (*Buteo buteo* (L.), Accipitridae) from Northen Italy. *Ann. Parasitol. Hum. Comp.*, 1982, *57* 203-208.
STABLER R. M., HOLT P. A. : Hematozoa from Colorado birds. II. Falconiformes and Strigiformes. *J. Parasitol.*, 1965, *51*, 927-928.
TENDEIRO J. : Acerca dos hematozoarios de algunas aves da Guiné Portuguesa. *Rev. Med. Vet.*, 1947, *4*, 285-346.
WHITE E. M., GREINER E. C., BENNETT G. F., HERMAN C. M. : Distribution of the hematozoa of Neotropical birds. *Rev. Biol. Trop.*, 1978, *26*, 43-102.
WINGSTRAND K. G. : On some haematozoa of Swedish birds with remarks on the schizogony of *Leucocytozoon sakharoffi*. Kungl. *Svenske Vetenskapsaka*, 1947, *24*, 1-31.
WOOUS K. H. : List of recent holarctic bird species non-passerines. *Ibis*, 1972, *115*, 612-638.
YAKUNIN M. P. : Blood parasites of wild birds of southeastern Kasakhstan (In Russian). *Tr. Inst. Zool. Akad. Nauk. Kaz.* SSR, 1972, *33*, 69-78.