

The Leucocytozoidae of South African birds. The Coliiformes and Coraciiformes

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The leucocytozoids of the avian orders Coliiformes and Coraciiformes are reviewed. *Leucocytozoon colius* of the Coliidae, *L. alcedinis* and *L. dacelo* of the Alcedinidae and *L. bucerotis* of the Bucerotidae are described as new species. *Leucocytozoon eurytomi*, *L. nyctornis* and *L. communis* of the Coraciidae, Meropidae and Upupidae respectively are redescribed. *Leucocytozoon coraciae*, *L. francae*, *L. leitaoi* and *L. melloi* are declared synonyms of *L. eurytomi*. *Leucocytozoon apiaster* of the Meropidae and *L. musajevi* of the Coraciidae have previously been declared *nomina nuda*.

Die leucocytozoïede bloedparasiete van die voëlordes Coliiformes en Coraciiformes word hersien. *Leucocytozoon colius* van die Coliidae, *L. alcedinis* en *L. dacelo* van die Alcedinidae en *L. bucerotis* van die Bucerotidae word as nuwe spesies beskryf. *Leucocytozoon eurytomi*, *L. nyctornis* en *L. communis* onderskeidelik van die Coraciidae, Meropidae en Upupidae word herbekryf. *Leucocytozoon coraciae*, *L. francae*, *L. leitaoi* en *L. melloi* word almal as sinonieme van *L. eurytomi* verklaar. *Leucocytozoon apiaster* van die Meropidae en *L. musajevi* van die Coraciidae is vroeër alreeds *nomina nuda* verklaar.

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The Coliiformes are an order of six species of mouse birds endemic to sub-Saharan Africa. Although quite numerous and generally highly visible, only a few individuals have been examined for haematozoa. Recently, however, a blood film from a speckled mousebird, was obtained from Lydenburg in the Transvaal. This blood film proved to contain an infection of a leucocytozoid which is herein described as *Leucocytozoon colius* n. sp.

The Coraciiformes represent a large, cosmopolitan avian order, considered by some authorities to be among the most evolutionarily advanced groups of non-passerine birds. The nine families comprising the order are the cosmopolitan kingfishers (Alcedinidae – 91 species), the widely distributed hornbills (Bucerotidae – 51 species) and bee-eaters (Meropidae – 25 species), the New World todies and motmots (Todidae – 5 species; Momotidae – 8 species), the monotypic cuckoo roller (Leptosomatidae) from Madagascar and the hoopoe (Upupidae), the endemic African wood hoopoes (Phoeniculidae – 7 species) and the rollers of the Old World family Coraciidae (16 species). Curiously, no leucocytozoid has been described (but they have been often reported, Bennett, Whiteway, & Woodworth-Lynas 1982) from either the kingfishers or the hornbills, the two families with the largest number of species. No leucocytozoid has been described from the todies, motmots and cuckoo rollers. *Leucocytozoon apiaster* and *L. nyctornis* have been

described from the bee-eaters and *L. communis* from the hoopoes. Six species and one subspecies of *Leucocytozoon*, *L. coraciae*, *L. eurytomi*, *L. francae*, *L. leitaoi*, *L. melloi*, and *L. musajevi* have all been described from the Coraciidae. The leucocytozoids of the Coraciiformes are reviewed herein and three new species, *Leucocytozoon dacelo* and *L. alcedinis* from the Alcedinidae and *L. bucerotis* from the Bucerotidae are described.

Materials and Methods

Materials used in this study were deposited in the collection of the International Reference Centre for Avian Haematozoa (IRCAH) by collaborators around the world. The blood smears were air-dried and usually fixed in 100% methanol or ethanol, although some material was also fixed with May-Grünwald-Giemsa. Some of the blood films were stained on location with either Giemsa's stain or one of the 'quick' stains; the rest of the smears were stained with Giemsa's after receipt at the Centre.

The morphological characters (Bennett, Earlé, Peirce, Huchzermeyer & Squires-Parsons 1991) were obtained by drawing the appropriate cell with the aid of a camera lucida and determining the lengths and areas with a Zeiss MOP-3 Digital Analyzer. As stated by Bennett *et al.* (1991), microgametocytes were subject to the same morphological scrutiny as the macrogametocytes and in most cases, both

the morphological form and the measurements proved to be virtually the same with the exception of the much larger and light staining parasite nucleus, typical of the apicomplexan parasites. In the interests of brevity, therefore, the measurements of the microgametocytes are not presented in tabular forms, but if a major variation from the macrogametocyte is noted, this variation is cited in text. Photomicrographs were taken with a Zeiss Photoscope III. All hapantotype, parahapantotype and other material used as the basis of these descriptions have been deposited in the collection of the International Reference Centre for Avian Haematozoa.

Taxonomic Review

COLIIFORMES

Coliidae

Leucocytozoon colius n. sp.

Type host: speckled mouse bird, *Colius striatus* Gmelin.

Type locality: Lydenburg, Transvaal, Republic of South Africa.

Macrogametocyte (Figures 1–2, Table 1). Parasite with round morph only. Parasite small, occupying 83% of the area of the host cell–parasite complex, circular to broadly ovoid, cytoplasm finely granular, with few vacuoles; parasite nucleus large, usually narrowly or broadly elliptical rarely ovoid or circular and lacking a marked karyosome, occupying about 22% of the area of the parasite; nucleus of host cell–parasite complex as a thin band, but sometimes forming a small cap, covering 38% of the periphery of the parasite and occupying 20% of the area of the host cell–parasite complex.

Microgametocyte (Figures 3, 4). Morphology closely similar to and all dimensions within one standard deviation of the macrogametocyte; nucleus very pale staining and frequently not visible as a discrete unit.

Basis of description. Hapantotype. Blood film no. 104891 from speckled mousebird *Colius striatus*, collected by de Swardt, 18 June, 1989, Lydenburg, Transvaal, Republic of South Africa.

Comments. *Leucocytozoon colius* is a nondescript, small leucocytozoid of an avian order endemic to the Ethiopian region. It is considered to be a new species on the basis of its occurrence in a separate order and on the assumption, as discussed by Fallis, Desser & Khan (1974), that leucocytozooids also show host familial and subfamilial specificity.

CORACIIFORMES

Zeiniev (1975) listed the names *Leucocytozoon musajevi* (from the European roller *Coracias garrulus*) and *Leucocytozoon apiaster* (from the European bee-eater *Merops apiaster*) from Russian coraciiforms, along with many other names, in a table but failed to present any descriptions or illustrations to support the use of these names. Peirce & Bennett (1979) considered these names to be classical examples of *nomina nuda*. They are not further considered in this present study. Similarly, Yakunin (1976) listed *Leucocytozoon zasukhini* in a table (from the olive bee-eater *Merops superciliosus* and 38 other species of avian hosts) but failed

at the time or subsequently to present a description of this leucocytozoid. It is another classical *nomen nudum*, and was so declared by Valkiunas (1989).

Alcedinidae

Leucocytozoon alcedinis n. sp.

Type host: ruddy kingfisher, *Halcyon coromanda* (Latham).

Type locality: Dalton Pass, Philippine Islands.

Macrogametocyte (Figure 5, Table 1). Parasite with only round morph. Parasite of medium size, occupying 75% of the area of the host cell–parasite complex, round to broadly ovoid; parasite nucleus small, round to ovoid, without marked karyosome, occupying 6% of the area of the parasite; vacuoles few and small; nucleus of host cell–parasite complex covering 68% of the periphery of the parasite as a thin uniform band without caps, occupying 24% of the area of the host cell–parasite complex.

Microgametocyte (Figure 6). Morphology closely similar to that of the macrogametocyte in all aspects, but is about 5% smaller in all dimensions; nucleus of microgametocyte stains extremely poorly and usually cannot be seen sufficiently clearly to permit measurements to be taken.

Basis of description. Hapantotype: Blood film no. 12348 from *Halcyon coromanda*, collected by McClure on 3 October, 1965, Dalton Pass, Philippine islands.

Additional host records and distribution. The striped kingfisher *Halcyon chelicuti* Transvaal, Republic of South Africa; white-breasted kingfisher *Halcyon smyrnensis*, Hong Kong, China. In low numbers, scattered throughout the Old World.

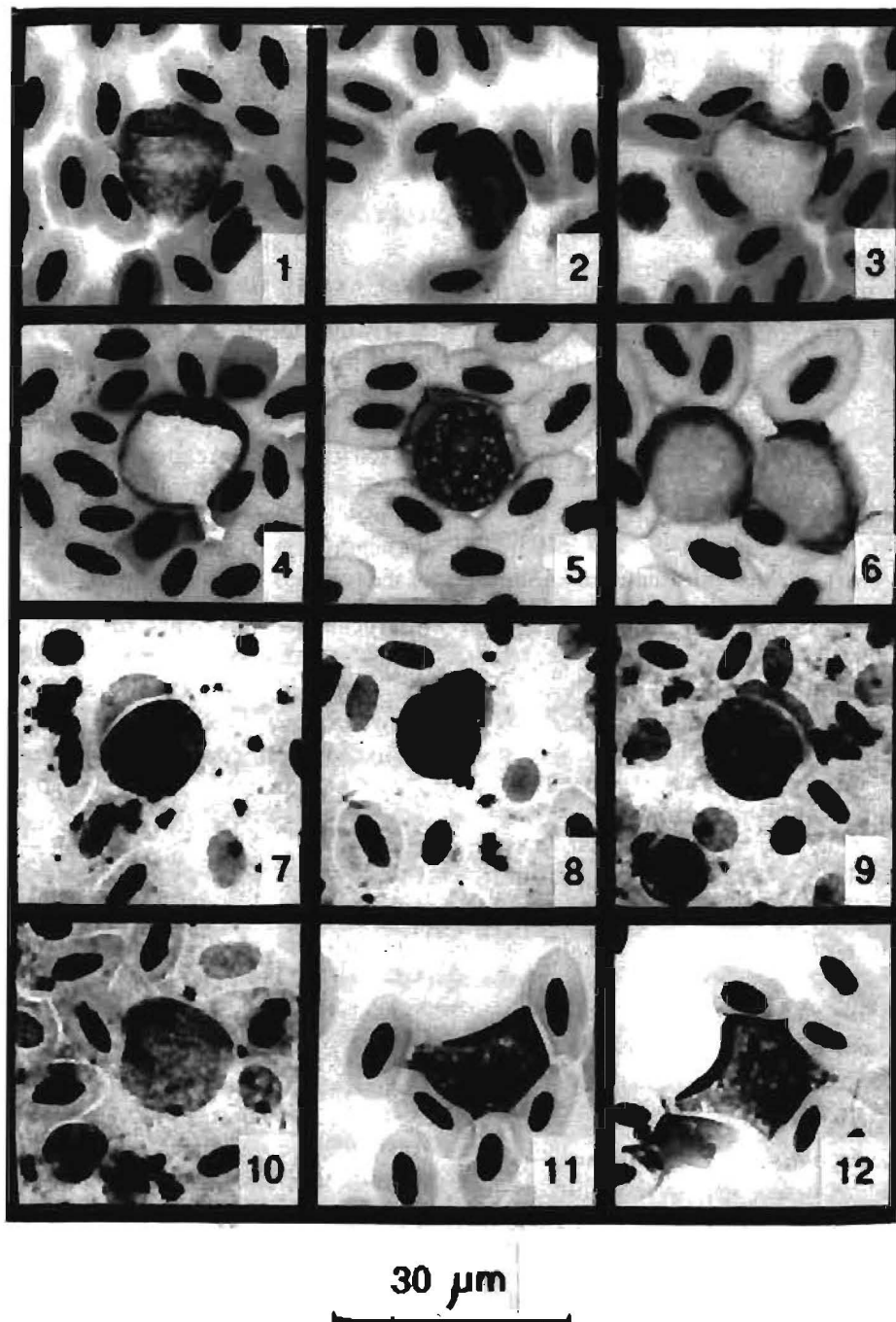
Comments. *Leucocytozoon alcedinis* is a nondescript, medium-sized leucocytozoid whose host cell–parasite complex nucleus covers about two-thirds of the periphery of the parasite. It is unique in that it occurs in the kingfishers, a group in which *Leucocytozoon* is seldom reported. In fact, of the 45 species of kingfishers examined for haematozoa (Bennett *et al.* 1982; IRCAH records), only nine species have been reported with *Leucocytozoon*. Three of these were infected with *Leucocytozoon alcedinis*, one in sub-Saharan Africa and two in south-eastern Asia. All infections with *L. alcedinis* were of low intensity, the hapantotype slide averaging about 1/10 000 erythrocytes and the other two less than 1/100 000 erythrocytes. The latter two were not used as parahapantotypes as the intensity of infection was so low.

Leucocytozoon dacelo n. sp.

Type host: the kookaburra, *Dactio novaeguineae* (Herman).

Type locality: Victoria, Australia.

Macrogametocyte (Figures 7–9, Table 1). Parasite with round morph only. Parasite small, occupying 80% of the area of the host cell–parasite complex, round; parasite nucleus small, round to ovoid, without marked karyosome, occupying 6% of the area of the parasite; vacuoles small and



Figures 1-4 *Leucocytozoon colius*. Figures 1, 2 — macrogametocytes; Figures 3, 4 — microgametocytes. Figures 5, 6 *Leucocytozoon alcedinis*. Figure 5 — macrogametocyte; Figure 6 — two microgametocytes. Figures 7-10 *Leucocytozoon dacelo*. Figures 7-9 — macrogametocytes; Figure 10 — microgametocyte. Figures 11-12 *Leucocytozoon bucerotis*. Figures 11, 12 — macrogametocytes.

few, nucleus of host cell-parasite complex as a pronounced cap, covering 35% of the periphery of the parasite and occupying 19% of the area of the host cell-parasite complex.

Microgametocyte (Figure 10). Morphology and dimensions closely similar in all respects to that of the macrogametocyte.

Basis of description. **Hapantotype:** Blood film no. 63074 from the kookaburra *Dacelo novaeguineae*, collected by Norman, 27 June, 1977, from Victoria, Australia. **Parahapantotype:** Blood film no. 38890 from the rufous-collared

kingfisher *Halcyon concreta*, collected by McClure, 5 July, 1967, Sarawak, Borneo.

Additional host records and distribution. White-collared kingfisher *Halcyon chloris* Philippine Islands; spotted wood kingfisher *Halcyon lindsayi*, Philippine Islands; pygmy kingfisher *Ispidina picta*, Entebbe, Uganda. Distributed in south-eastern Asia and Africa, and presumably throughout the Old World range of the Alcedinidae.

Comments. *Leucocytozoon dacelo* is a small parasite, one of the smallest round morph leucocytozoids described. The host cell-parasite nucleus forms a highly distinctive and

Table 1 Morphometric parameters (in μm) of the macrogametocytes of the leucocytozoids of the Coliidae, Alcedinidae and Bucerotidae. n = sample size; means followed by standard deviations in parentheses

	<i>L. colius</i> $n = 25$	<i>L. alcedinis</i> $n = 10$	<i>L. dacelo</i> $n = 39$	<i>L. bucerotis</i> $n = 65$
Parasite and its nucleus				
maximum diameter/length	14,1 (1,1)	14,5 (1,7)	11,6 (1,0)	15,1 (1,7)
minimum diameter/width	11,0 (1,4)	12,2 (0,7)	10,3 (1,0)	11,6 (2,2)
periphery of parasite	41,5 (2,4)	43,9 (2,8)	35,4 (2,4)	43,4 (3,7)
area of parasite	125,7 (12,1)	139,6 (15,5)	95,9 (12,7)	137,6 (25,8)
maximum diameter nucleus	5,9 (1,3)	4,0 (0,4)	3,2 (0,7)	4,7 (1,5)
minimum diameter nucleus	2,4 (0,7)	2,8 (0,5)	2,3 (0,5)	2,3 (0,5)
area of nucleus	10,7 (2,4)	8,0 (1,6)	5,6 (1,7)	8,2 (2,5)
Host cell-parasite complex				
maximum length/diameter	15,5 (1,1)	17,1 (1,5)	13,8 (1,2)	16,6 (2,0)
minimum length/diameter	12,7 (1,1)	14,1 (1,3)	11,1 (0,9)	13,0 (2,1)
area of complex	150,0 (12,0)	183,9 (20,4)	118,2 (14,2)	166,1 (29,7)
amount parasite periphery				
covered by complex nucleus	14,5 (1,8)	29,9 (3,7)	12,8 (3,9)	17,6 (2,7)
area of complex nucleus	24,2 (6,1)	44,4 (12,0)	22,5 (4,5)	28,4 (7,0)

prominent cap. This parasite is easily distinguished from the other species, *L. alcedinis* of the kingfishers by (i) its small size (about two-thirds) and (ii) the distinctive cap-like host cell-parasite nucleus covering only 35% of the parasite periphery compared to the thin, uniform band-like host cell-parasite nucleus covering 65% of the periphery.

Bucerotidae

Leucocytozoon bucerotis n. sp.

Type host: red-billed hornbill, *Tockus erythrorhynchus* (Temm.)

Type locality: South Horr, Kenya.

Macrogametocyte (Figures 11–13, Table 1). Parasite with round morph only. Parasite small, occupying 83% of the area of the host cell-parasite complex, round to broadly ovoid; parasite nucleus round to elliptical, frequently with pronounced karyosome, occupying 6% of the area of the parasite; vacuoles present and medium large; nucleus of host cell-parasite complex variable, sometimes as cap or as thin band or as a band with one end raised into a small point (or cap), covering 41% of the periphery of the parasite and occupying 17% of the host cell-parasite complex, volutin granules frequently present.

Microgametocyte (Figure 14). Morphology similar to that of the macrogametocyte but all dimensions 10–20% smaller; volutin granules sometimes present but few in number.

Basis of description. Hapantotype: Blood film no. 77478 from *Tockus erythrorhynchus*, coll. Peirce, 24 September, 1970, South Horr, Kenya. **Parahapantotype:** Blood film no.108483 from Monteiro's hornbill *Tockus montei*, collected by Kemp, 23 March, 1989, Republic of South Africa; blood film. no.61631 from Papuan hornbill *Aceros plicatus*, collected by Chatten and Beecher, 12 July, 1944, Guadalcanal Solomon Islands.

Additional host records and distribution. Van der Decken's hornbill *Tockus deckeni*, Kenya; black hornbill, *Anthracoceros malayanus*, Malaysia. Distributed throughout eastern Africa, south-eastern Asia to the Solomon Islands and presumably throughout the distributional range of the Bucerotidae.

Comments. *Leucocytozoon bucerotis* is a small, round leucocytozoid with little distinctive morphology to distinguish it from other round morph species. It is considered to be a distinct species because of its occurrence in a distinctive avian family.

Coraciidae

Leucocytozoon eurystomi Kerandel, 1913

Type host: Blue-throated roller *Eurystomus gularis* Meillot

Type locality: Haute Sangha, Belgian Congo

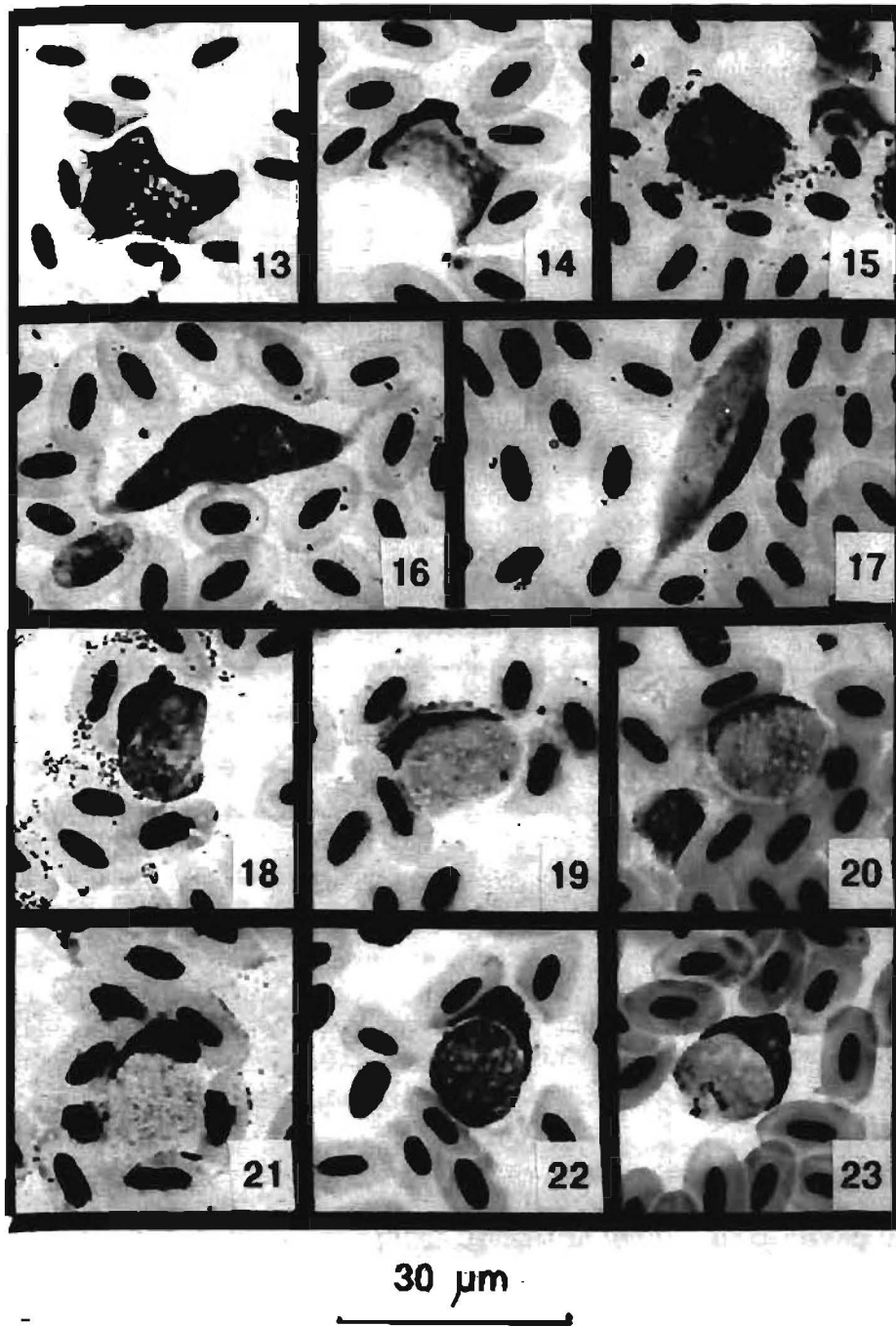
Synonyms: *Leucocytozoon coraciae* de Mello & Afonso, 1935, emend Bhatia, 1938

Leucocytozoon francae Tendeiro, 1947, emend Hsu, Campbell & Levine, 1973

Leucocytozoon leitaoui Tendeiro, 1947, emend Bray, 1964

Leucocytozoon melloi Bhatia, 1938

Macrogametocyte (Figures 15, 16, Table 2). Parasite with both round and fusiform morphs. **Round morph** (Figure 15). Parasite small, occupying 80% of the area of the host cell-parasite complex, round to broadly ovoid; parasite nucleus round to ovoid, usually with marked karyosome, occupying 7% of the area of the parasite; vacuoles not prominent; nucleus of host cell-parasite complex as a distinct cap or bulb, covering only 26% of the parasite periphery and occupying 20% of the area of the host cell-parasite complex. **Fusiform morph** (Figure 16).



Figures 13–14 *Leucocytozoon bucerotis*. Figure 13 — macrogametocyte; Figure 14 — microgametocyte. **Figures 15–18** *Leucocytozoon eurystomi*. Figure 15 — macrogametocyte, round morph; Figure 16 — macrogametocyte, fusiform morph; Figure 17 — microgametocyte, fusiform morph; Figure 18 — microgametocyte, round morph. **Figures 19–21** *Leucocytozoon nyctiornis*. Figures 19, 20 — macrogametocyte; Figure 21 — microgametocyte. **Figures 22, 23** *Leucocytozoon communis*. Figure 22 — macrogametocyte; Figure 23 — microgametocyte.

Parasite of large size, occupying 90% of the area of the host cell–parasite complex, ovoid to elliptical in shape but not round; parasite nucleus small, ovoid to elliptical with marked karyosome, occupying 6% of the area of the parasite; vacuoles not prominent; nucleus of the host cell–parasite complex covering 26% of the periphery of the parasite and occupying 19% of the area of the host cell–parasite complex, the cytoplasmic horns of the fusiform parasite rather short and generally sharply pointed.

Microgametocyte (Figures 17,18). Both round and fusi-

form morphs closely similar in morphology and dimensions to the macrogametocyte; parasites less than 5% smaller than the macrogametocyte.

Basis of description. Neohapantotype. Blood film no. 46093 from *Coracias abyssinica*, coll. Blancou, April 24, 1976, Dakar, Senegal.

Additional host records and distribution. All *Leucocytozoon* infections of Coraciidae listed by Bennett *et al.* (1982) can be assigned to this species. Throughout the Old World

Table 2 Morphometric parameters (in μm) of the leucocytozoids of the Coraciidae, Meropidae and Upupidae. n = sample size; means followed by standard deviations in parentheses; F = fusiform and R = round, morphs

	<i>L. eurystomi</i>		<i>L. nyctornis</i> $n = 15$	<i>L. communis</i> $n = 30$
	R $n = 8$	F $n = 20$		
Parasite and its nucleus				
maximum diameter/length	13,4 (1,8)	28,0 (2,3)	13,6 (1,8)	13,6 (1,2)
minimum diameter/width	11,2 (1,3)	9,1 (0,7)	10,8 (1,6)	11,0 (1,0)
periphery of parasite	42,0 (5,4)	63,0 (5,9)	41,2 (4,1)	39,9 (2,7)
area of parasite	128,7 (29,4)	182,0 (18,5)	120,0 (16,6)	116,7 (17,4)
maximum diameter nucleus	4,5 (0,8)	5,2 (0,8)	3,7 (0,6)	4,1 (0,8)
minimum diameter nucleus	2,7 (0,7)	3,0 (0,6)	2,3 (0,4)	2,6 (0,4)
area of nucleus	9,3 (3,2)	11,8 (2,6)	7,0 (2,4)	8,3 (2,1)
Host cell-parasite complex				
maximum length/diameter	15,7 (2,8)	39,2 (6,3)	15,2 (1,6)	16,0 (1,9)
minimum length/diameter	15,7 (2,8)	9,1 (0,7)	12,2 (1,3)	12,6 (1,5)
area of complex	161,4 (32,8)	202,2 (21,1)	147,1 (18,6)	151,8 (23,8)
amount parasite periphery				
covered by complex nucleus	11,1 (2,4)	16,9 (2,3)	20,5 (4,5)	13,8 (2,4)
area of complex nucleus	32,8 (8,2)	39,0 (7,2)	27,2 (6,7)	35,1 (10,0)

distribution of the family Coraciidae.

Comments. de Mello & Afonso (1935) described two species of leucocytozoids from the Indian roller, *Coracias benghalensis*. The first species (their type A) was a fusiform parasite to which they gave the trinomial, *Leucocytozoon coraciac benghalensis*, subsequently emended by Bhatia (1938) to *Leucocytozoon coraciae*. Their second leucocytozoid (their type B) was a round form, and de Mello and Afonso were convinced that this was a second species of *Leucocytozoon*, and made a case to create for it a new genus; they pursued this line of reasoning at the International Congress of Zoology in 1936 (de Mello 1937). They made the widely prevalent error of the time in failing to understand that some leucocytozoids had both round and fusiform morphs. In 1938, Bhatia made a compilation of the Sporozoa of British India, presenting in précis form the descriptions of blood parasites made by de Mello and others. Bhatia took de Mello and Afonso's type B parasite from the Indian roller and raised it to specific rank under the designation *Leucocytozoon melloi*.

The illustrations presented by de Mello and Afonso for these leucocytozoids of the Indian roller are closely similar to the illustrations and description of *Leucocytozoon eurystomi* and they are herewith declared synonyms. Neither Bhatia nor de Mello apparently were aware of Kerandel's (1913) work. Valkiunas (1989) also made the same error, and did not recognize that the round form as the hepatic cycle of *L. coracias*. He redescribed *L. melloi* from the European roller *Coracias garrulus*, as well as redescribing *L. coracias* from the same host. He was unaware of Kerandel's work and did not recognize that both *L. coracias* and *L. melloi* were synonyms of *L. eurystomi*. He was aware, however, that *L. leitai* was the same as *L. coracias*. Valkiunas's measurements and drawings (including the marked karyosome feature) are similar.

Tendeiro (1947) described *Leucocytozoon leitai* from the Abyssinian roller *Coracias abyssinica* and *Leucocytozoon francae*, from the broadbilled roller *Eurystomus afer* (= *glaucurus*). Both species had round and fusiform morphs and the dimensions and figures presented for both species show that they are the same. They were called different species on the 'one host - one parasite' philosophy, a philosophy which possibly prompted him to ignore Kerandel's (1913) work, as *L. eurystomi* was from a different host from the birds he worked with. Tendeiro did not compare his measurements with those presented by Kerandel. However, both *L. leitai* and *L. francae* are clearly the same as each other and are the same as *L. eurystomi*, and are therefore considered to be synonyms of *L. eurystomi*.

Kerandel (1913) gave no indication of designation of type material or where it might have been deposited. A neohapantotype blood smear from a coraciid from West Africa (Senegal) was selected as the best available material from the same geographic region.

Meropidae

Leucocytozoon nyctornis Nandi, 1986

Type host: the blue-bearded bee-eater, *Nyctornis athertoni* (Jardine and Selby)

Type locality: Rani, Assam, India.

Macropmetocyte (Figures 19, 20, Table 2). Parasite with round morphs only. Parasite of small size, occupying 80% of the area of the host cell-parasite complex, round to broadly ovoid; parasite nucleus round to ovoid, without marked karyosome, occupying 6% of the area of the parasite; vacuoles not prominent; nucleus of host cell-parasite complex as a thin band (rarely with a cap-like appearance) covering 50% of the periphery of the parasite and occupying 18% of the host cell-parasite complex.

Microgametocyte (Figure 21). Similar morphologically to the macrogametocyte but about 10% larger in most dimensions; among the leucocytozoids, microgametocytes are usually smaller than the macrogametocytes.

Basis of description. Blood film no. 37195 from the blue-throated bee-eater *Merolis viridis*, collected by McClure, 5 June, 1967, Dalton Pass, Philippine Islands.

Additional host records and distribution. Nandi (1986) has summarized the meropid hosts of *Leucocytozoon nyctyornis*, and all species of bee-eaters listed by Bennett *et al.* (1982) can be considered as hosts of this species which is presumably distributed throughout the range of the Meropidae.

Comments. *Leucocytozoon nyctyornis* is another small, nondescript round leucocytozoid which is considered to be a separate species by its occurrence in a separate avian family. The measurements provided in this study are with \pm one standard deviation of the measurements presented by Nandi (1986), who based his description on the protocols initially established by Bennett, Khan & Campbell (1974). The present description expands the morphological criteria used according to the protocols of Bennett *et al.* (1991).

Upupidae

Leucocytozoon communis Valkiunas, 1989

Type host: the hoopoe, *Upupa epops* L.

Type locality: Khazakistan SSR.

Macrogametocyte (Figure 22, Table 2). Parasite with round morph only. Parasite small, occupying 75% of the area of the host cell-parasite complex, generally round to broadly ovoid; parasite nucleus fairly large, round to ovoid, occupying 7% of the area of the parasite; vacuoles not prominent; nucleus of host cell-parasite complex as a uniform band with a slight thickening (cap) in the centre, covering 35% of the periphery of the parasite and occupying 23% of the host cell-parasite complex.

Microgametocyte (Figure 23). Morphology of the microgametocyte closely similar to that of the macrogametocyte; parasite averages 5% smaller in most dimensions.

Basis of description. Blood film no. 114253a, b, c from *Upupa epops* collected by Bennett, 24 November (a) and 25 December, (b, c) 1990 respectively at Onderstepoort, Transvaal, Republic of South Africa.

Additional host records and distribution. All leucocytozoid records from the monotypic family Upupidae can probably be ascribed to this species which presumably has a distribution that covers the distributional range of the hoopoe.

Comments. *Leucocytozoon communis* is another small, nondescript leucocytozoid with little to distinguish it. Its occurrence in the monotypic Upupidae is the reason for considering this parasite to be a distinct species.

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