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The haemoproteids of the Cuculidae

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Abstract

The haemoproteids of the avian family Cuculidae are reviewed and a redescription of *Haemoproteus centropi* of the Centropodinae presented. *Haemoproteus cuculis* sp. nov. and *Haemoproteus clamatori* sp. nov. are described from the Cuculinae.

Keywords: *Cuculidae*, *distribution*, *Haemoproteus*, *morphology*, *new species*, *taxonomy and systematics*

Introduction

Recent advances in avian systematics based on their DNA–DNA hybridization data and distribution have resulted in the establishment of six distinct subfamilies within the Cuculidae (Payne 1997). This has resulted in cuckoos of the genus *Centropus* Illiger being placed in the subfamily Centropodinae. As a consequence of these developments and based on the host-specificity of avian haemoproteids at the family and subfamily level (Bennett and Peirce 1988), a reappraisal has been undertaken into the status of *Haemoproteus centropi* De Mello, the only species previously described from the Cuculidae. Since De Mello (1935) described this species from shot birds, blood from which is unsuitable for taxonomic study, the parasite was redescribed by Peirce (1977) from *Clamator jacobinus* Boddaert from Kenya. Although Peirce (1977) did not designate his specimens as neohapantotypes, Garnham subsequently ascribed them thus in his collection to which some of the slides had been deposited (Garnham and Duggan 1986). Clearly in the light of recent developments this designation is no longer valid. Thus the original slides used by Peirce (1977) together with all other Cuculidae material deposited in the International Reference Centre for Avian Haematozoa (IRCAH) collection has been evaluated and the results described herein.

Materials and methods

All stained blood smears (most with Giemsa) from Cuculidae deposited in the IRCAH collection together with those deposited in the Garnham Collection (now in the Natural

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History Museum, London) were screened and their status evaluated. Employing the methods established by Bennett and Campbell (1972), morphometric parameters were determined.

Results

The results of the study demonstrate that *Haemoproteus centropi* is the only valid species occurring in the Centropodinae and two hitherto undescribed species occur in the Cuculinae. A redescription of *H. centropi* and descriptions of the two new species are presented below.

Taxonomic review

Family CUCULIDAE (the cuckoos)

Subfamily CUCULINAE (Old World parasitic cuckoos)

Parasite: *Haemoproteus cuculis* sp. nov.
(Figure 1A–C)

Type host. *Eudynamys scolopacea* (L.).

Type locality. Gold Coast, Queensland, Australia.

Vector. Unknown, but assumed to be either hippoboscid or ceratopogonid.

Etymology. Named for the host family.

Immature gametocyte. Early forms occupy any position within the host cell and are amoeboid (Figure 1A, C). This amoeboid morphology is maintained as the parasite grows and occupies a lateral position within the erythrocyte. Vacuoles may be present in parasite cytoplasm.

Macrogametocyte (Figure 1B; Table I). Mature parasites present the usual sexual differentiating characteristics. Parasite halteridial with irregular and amoeboid outlines, although some parasites may be smooth and almost entire; occupying about 60% of the host cell cytoplasm. Nucleus is compact, generally round and usually located centrally; pigment granules evenly scattered throughout the parasite cytoplasm being fine, round and golden brown in colour and averaging 26.1. Mature parasite causes some lateral displacement of the host cell nucleus with 4–12% hypertrophy in length and width and 15% in area.

Microgametocyte (Figure 1C; Table I). Similar in shape to the macrogametocyte and presenting the usual staining characteristics. Nucleus diffuse, usually central and staining pale pink; parasite cytoplasm pale and may contain some degree of vacuolation. Pigment granules averaging 19.7 may be either scattered throughout the cytoplasm or concentrated at the poles. Mature parasite causes some lateral displacement of the host cell nucleus with some 4–11% hypertrophy in length and width and 14% in area.

Ratio of macrogametocytes to microgametocytes is 62:38. Multiple invasion of erythrocytes not observed.

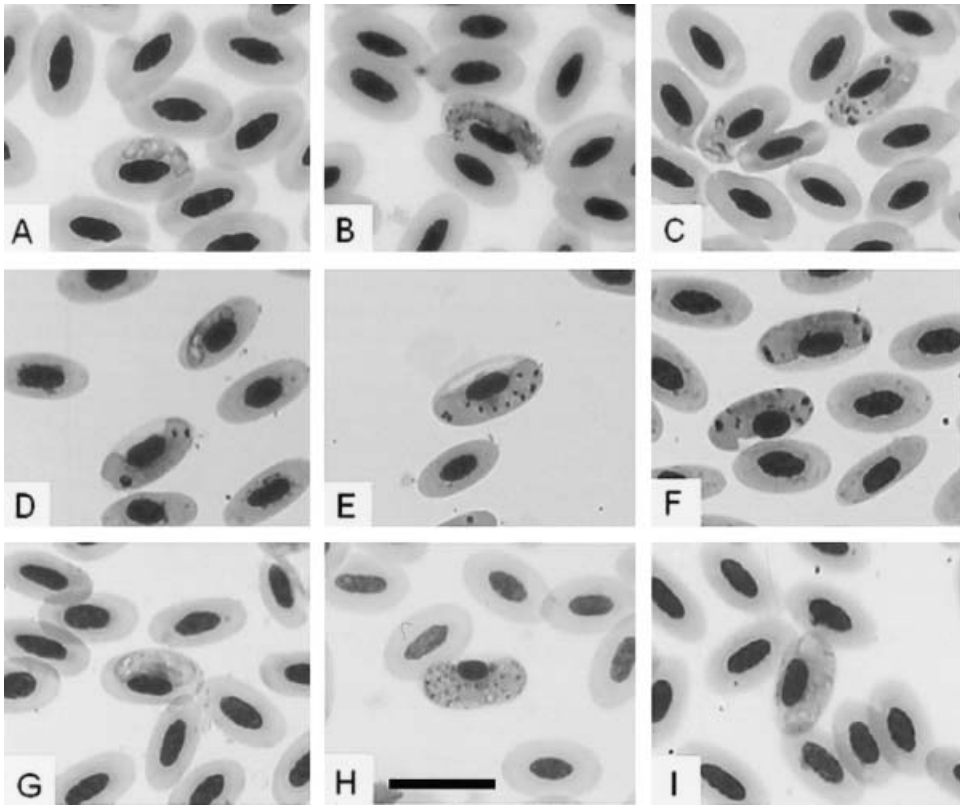


Figure 1. (A–C) *Haemoproteus cuculis* sp. nov.: (A) immature gametocyte; (B) macrogametocyte; (C) microgametocyte (upper) and immature gametocyte (lower). (D–F) *Haemoproteus centropi*: (D) immature gametocyte (upper) and almost mature microgametocyte (lower); (E) macrogametocyte; (F) two microgametocytes. (G–I) *Haemoproteus clamatori* sp. nov.: (G) immature gametocyte; (H) macrogametocyte; (I) microgametocyte. Scale bar: 14 μ m.

Hapantotype: IRCAH: G463587 from *E. scolopacea* coll. Currumbin Wildlife Sanctuary, 6 November 2000, Gold Coast, Queensland, Australia. Parahapantotype: IRCAH: G403118 from *E. scolopacea* coll. Kuntz, 6 March 1965, Palawan, Philippines.

Comments. *Haemoproteus cuculis* is currently known only from Australia and the Philippines. Presumably it occurs throughout the Australasian–Oriental region. It remains to be determined if it occurs throughout the distributional range of the Cuculinae.

Parasite: *Haemoproteus clamatori* sp. nov.
(Figure 1G–I)

Type host. *Clamator jacobinus* Boddaert.

Type locality. Ngulia, Kenya.

Vector. Unknown, but assumed to be either hippoboscid or ceratopogonid.

Table I. Morphometric parameters of *Haemoproteus cuculis*, *H. clamator* and *H. centropi*.

	<i>H. cuculis</i> (n=25)	<i>H. clamator</i> (n=25)	<i>H. centropi</i> (n=25)
Uninfected erythrocyte			
Length	13.5 (0.6)	12.2 (0.5)	12.6 (0.5)
Width	7.6 (0.5)	6.9 (0.6)	6.3 (0.6)
Area	80.5 (9.5)	65.9 (5.2)	62.9 (8.1)
Uninfected erythrocyte nucleus			
Length	6.6 (0.5)	6.2 (0.4)	5.4 (0.6)
Width	2.6 (0.2)	2.6 (0.2)	2.9 (0.2)
Area	13.5 (1.7)	12.8 (1.9)	12.7 (1.9)
Infected erythrocyte macrogametocyte			
Length	15.3 (0.7)	14.0 (0.9)	14.6 (1.1)
Width	7.9 (0.6)	7.9 (0.6)	7.0 (0.6)
Area	94.6 (9.3)	87.1 (7.6)	80.6 (7.6)
Infected erythrocyte nucleus			
Length	6.4 (0.7)	5.4 (0.6)	5.4 (0.7)
Width	2.5 (0.3)	2.8 (0.3)	2.9 (0.3)
Area	12.7 (2.5)	11.9 (1.2)	12.3 (2.2)
Macrogametocyte			
Length	14.3 (1.2)	13.7 (1.5)	14.1 (1.3)
Width	3.6 (0.6)	4.1 (0.7)	2.6 (0.3)
Area	53.5 (6.4)	55.8 (6.2)	37.3 (5.4)
Macrogametocyte nucleus			
Length	2.1 (0.4)	2.5 (0.5)	2.6 (0.4)
Width	1.7 (0.3)	1.9 (0.3)	1.7 (0.2)
Area	3.7 (0.8)	5.1 (1.4)	4.3 (1.1)
Pigment granules	26.1 (3.0)	14.3 (2.5)	13.3 (1.9)
NDR	0.6 (0.1)	0.4 (0.2)	0.6 (0.2)
Infected erythrocyte microgametocyte			
Length	15.2 (1.7)	14.2 (1.0)	14.0 (1.7)
Width	7.9 (0.5)	7.8 (0.5)	6.8 (0.5)
Area	93.5 (8.4)	86.7 (8.4)	75.5 (6.4)
Infected erythrocyte nucleus			
Length	6.2 (0.7)	5.6 (0.7)	5.3 (0.6)
Width	2.5 (0.1)	2.7 (0.3)	2.7 (0.1)
Area	12.3 (2.3)	11.9 (2.1)	11.3 (2.1)
Microgametocyte			
Length	14.5 (1.4)	13.7 (1.7)	13.5 (2.2)
Width	3.1 (0.6)	5.9 (0.7)	2.6 (0.5)
Area	47.7 (5.6)	52.5 (7.2)	34.9 (5.2)
Microgametocyte nucleus			
Length	6.2 (1.0)	7.2 (1.0)	6.9 (1.0)
Width	2.4 (0.4)	3.0 (0.5)	2.2 (0.4)
Area	17.2 (3.4)	21.9 (3.8)	15.5 (2.8)
Pigment granules	19.7 (2.1)	16.3 (2.1)	12.0 (1.3)
NDR	0.7 (0.1)	0.6 (1.1)	0.6 (0.2)

All measurements are in micrometres and are presented as means followed in parentheses by the standard deviation. NDR, nuclear displacement ratio.

Etymology. Named for the type host genus.

Immature gametocyte. Generally occupies a lateral position within the erythrocyte with marked displacement of host cell nucleus. Margins entire with rounded, smooth poles (Figure 1G).

Macrogametocyte (Figure 1H; Table I). Mature parasites present the usual staining and sexual differentiating characteristics. Parasite entire, halteridial with smooth rounded ends; occupying about 90% of host cell cytoplasm. Nucleus, compact and central; pigment granules averaging 14.3 scattered throughout the cytoplasm; variable texture from pale yellow to dark brown. In some parasites pigment granules are almost absent, but small, round, purple volutin granules are usually present. Lateral displacement of host cell nucleus with 13% hypertrophy in length and width and 25% in area.

Microgametocyte (Figure 1I; Table I). Similar in shape to the macrogametocyte and presenting the usual staining characteristics. Nucleus generally central but very diffuse; staining pale pink; pigment granules averaging 16.3 may be scattered or concentrated at the poles. As with the macrogametocyte there is marked displacement of the host cell nucleus with hypertrophy of 12–14% in length and width and 24% in area.

Ratio of macrogametocytes to microgametocytes is 68:32. Multiple invasion of erythrocytes occasionally present.

Hapantotype: Garnham Collection 978 (Natural History Museum, London) from *Clamator jacobinus* coll. Peirce, 26 November 1975, Ngulia, Kenya. Parahapantotypes: Garnham Collection 979 (Natural History Museum, London) from *C. jacobinus* coll. Peirce, 7 December 1975, Ngulia, Kenya; IRCAH: G428182 from *C. jacobinus* coll. Peirce, 26 February 1975, Ngulia, Kenya; IRCAH: G428184 from *C. jacobinus* coll. Peirce, 22 February 1971, Ngulia, Kenya; IRCAH: G463586 from *E. scolopacea* coll. Currumbin Wildlife Sanctuary, 10 March 1999, Gold Coast, Queensland, Australia.

Other hosts. *Clamator levaillantii* (Swainson), *C. coromandus* (L.) and *Cacomantis merulinus* (Scopoli). Presumably occurs throughout the distributional range of the Cuculinae.

Comments. The description of *H. clamator* is based on the original material used by Peirce (1977) together with additional slides from the IRCAH collection and a more detailed range of morphometric measurements. As a consequence of this review the slides in the Garnham Collection and the IRCAH have been redesignated.

Family CUCULIDAE
Subfamily CENTROPODINAE (coucals)

Parasite: *Haemoproteus centropi* De Mello, 1935
(Figure 1D–F)

Synonym: *Haemoproteus froilanoi* Tendeiro, 1947.

Type host. *Centropus sinensis parroti* Stresemann.

Type locality. Daman, India.

Vector. Unknown, but assumed to be either hippoboscid or ceratopogonid.

Basis of redescription

Immature gametocyte. May occupy any position within the erythrocyte and the smallest forms may be slightly amoeboid. As the parasites grow they occupy a lateral position to the host cell nucleus (Figure 1D) and the outline is generally entire.

Macrogametocyte (Figure 1E; Table I). Displays the usual differentiating staining and sexual characteristics. Parasites halteridial, generally entire with smooth outlines, although a few parasites may demonstrate a small degree of irregularity; occupying about 65% of host cell cytoplasm. Nucleus is compact, but irregular in outline, usually in a central position. Pigment granules averaging 13.3 are dark brown and irregular in shape; scattered throughout the cytoplasm. Mature parasite causes lateral displacement of host cell nucleus with hypertrophy of 10% in length and width with 22% in area.

Microgametocyte (Figure 1F; Table I). Similar to macrogametocyte presenting the usual differentiating characteristics. Nucleus central and diffuse; staining deep pink. Pigment granules averaging 12 usually concentrated at the poles. Mature parasite causes some lateral displacement of the host cell nucleus with hypertrophy of 8–10% in length and width with 17% in area.

Ratio of macrogametocytes to microgametocytes is 45:55. No multiple invasion of erythrocytes observed.

Neohapantotype: IRCAH: G454367 from *Centropus toulou insularis* Ridgway coll. Lowery, 1968, Aldabra, Indian Ocean. Paraneohapantotypes: IRCAH: G463584 from *Centropus phasianinus* (Latham) coll. Currumbin Wildlife Sanctuary, 17 July 2000, Gold Coast, Queensland, Australia; IRCAH: G463585 from *C. phasianinus* coll. Currumbin Wildlife Sanctuary, 12 September 2000, Gold Coast, Queensland, Australia.

Other hosts. *Centropus sinensis parroti*, *C. senegalensis* (L.), *C. milo* Gould, *C. supercilliosus* Hemprich and Ehrenberg, and presumably throughout the range of the Centropodinae.

Comments. The original description of *H. centropi* by De Mello (1935) is unacceptable as it was based on material from a shot bird and no hapantotype exists. Likewise, the description of *H. froilanoi* by Tendeiro (1947) is clearly a synonym of *H. centropi* and no hapantotype is known to exist. The family Centropodinae comprises the single genus *Centropus* with some 28 species.

The genus has a wide distribution through Africa, Asia and Australia and whilst there is considerable overlap with species of the Cuculinae, there is no evidence of cross-infection with other species of *Haemoproteus*.

Discussion

The above review clearly demonstrates that the redescription of *H. centropi* by Peirce (1977) from species of *Clamator* was in error. The changes in avian systematics based on DNA–DNA hybridization data (Payne 1997) is supported by the apparent host specificity of the haemoproteids described here. This evidence further supports the views of Bennett and Peirce (1988) who first suggested that most species of *Haemoproteus* were host-specific at the family and in many instances the subfamily level. Some changes may occur in the future when molecular studies are more widely available, but the evidence from the morphometric data in Table I and the photographic evidence from the figures clearly show the validity of the three species described herein.

At the present time insufficient material is available to determine how many other species of *Haemoproteus* may be present in the remaining four subfamilies of the Cuculidae.

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