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Author: ASHFORD, R. W.

Source: Journal of Wildlife Diseases, 12(3) : 409-426

Published By: Wildlife Disease Association

URL: <https://doi.org/10.7589/0090-3558-12.3.409>

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BLOOD PARASITES OF ETHIOPIAN BIRDS

1. GENERAL SURVEY*

R. W. ASHFORD,^[1] Wellcome Parasitology Unit No. 2, Institute of Pathobiology,
Haile Sellasie I University, Addis Ababa, Ethiopia

T. T. PALMER,^[2] U.S. Naval Research Unit No. 5, APO New York 09319, USA

J. S. ASH, Department of Vertebrate Zoology, Smithsonian Institution,
U.S. Naval Medical Research Unit No. 5, APO New York 09319

R. S. BRAY,^[3] Wellcome Parasitology Unit No. 2

Abstract: Five thousand and forty-six smears from 352 species of birds in Ethiopia were examined for blood parasites in an attempt to provide base-line data, to indicate fruitful areas for further study, on avian hematozoa. The prevalence of infection and the parasites found, with particular reference to *Plasmodium*, are discussed. At least 22 parasite species were recognized.

INTRODUCTION

The blood parasites of African birds are known largely from isolated records, most often from game species. Published surveys rarely include large numbers of individuals and species or negative results. Two recent papers,^{13,14} indicate the need for more comprehensive surveys to provide baseline data with which limited studies may be compared. The present work attempts to provide these baseline data for the avian hematozoa of Ethiopian birds, the survey having been undertaken primarily to indicate fruitful areas for further study. Further detailed work is necessary to provide data on vectors, transmission cycles and other avian hosts. In Egypt,¹¹ blood smears from 63 species, mostly Palearctic, were examined, but only seven of these are represented in the present work. A large amount of new

data, together with a summary of previous data, has been presented on West African avian hematozoa.⁵ There is further information in the literature on the blood parasites of some birds in Kenya,⁷ and Ethiopia,^{2,8,15} and on the malaria parasites of African birds.⁹

MATERIALS AND METHODS

The majority of the birds were captured in mist-nets in the five major lowland areas of Ethiopia marked on the map (Figure 1). The remainder were caught in Addis Ababa and other scattered highland localities. A maximum of 10 specimens from each species was sought from each area although larger numbers were taken occasionally. The survey was conducted from December, 1969 to April, 1972.

* The opinions and assertions contained herein are the private ones of the authors and are not to be construed as official or reflecting the view of the Navy Department or the Naval Service at large. The research was supported in part by the Bureau of Medicine and Surgery work unit Nos. MF 12.524.009.BB61, MF 51.524.009.3016B and MR 041.09.01-0014D6HJ, and Office of Naval Research Task Order No. NOO014-57-A-0399-0009.

[1] Present address: Department of Parasitology, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, U.K.

[2] Present address: U.S. Naval Medical Research Institute, Bethesda, Maryland 20014, USA.

[3] Present address: Medical Research Council Laboratories, Fajara, nr. Bathurst, The Gambia.

Birds were bled by clipping a claw, or by cardiac or jugular puncture. In the latter case a drop of blood was deposited for immediate smearing before the rest was collected in connection with arbovirus studies. Bloodfilms were fixed with methanol and returned to the laboratory for processing. They were later stained with Giemsa or a combination of Wright's and Giemsa. Most birds were ringed following bleeding, and recapture

data show that there was good survival following both cardiac and jugular puncture as noted elsewhere.⁶

The checklist⁶ nomenclature and sequence are followed in the text and tables.

Most of the collecting and host identification was undertaken by J. S. A. Parasite determinations were made by the other authors, often following screening of the slides by NAMRU technicians.

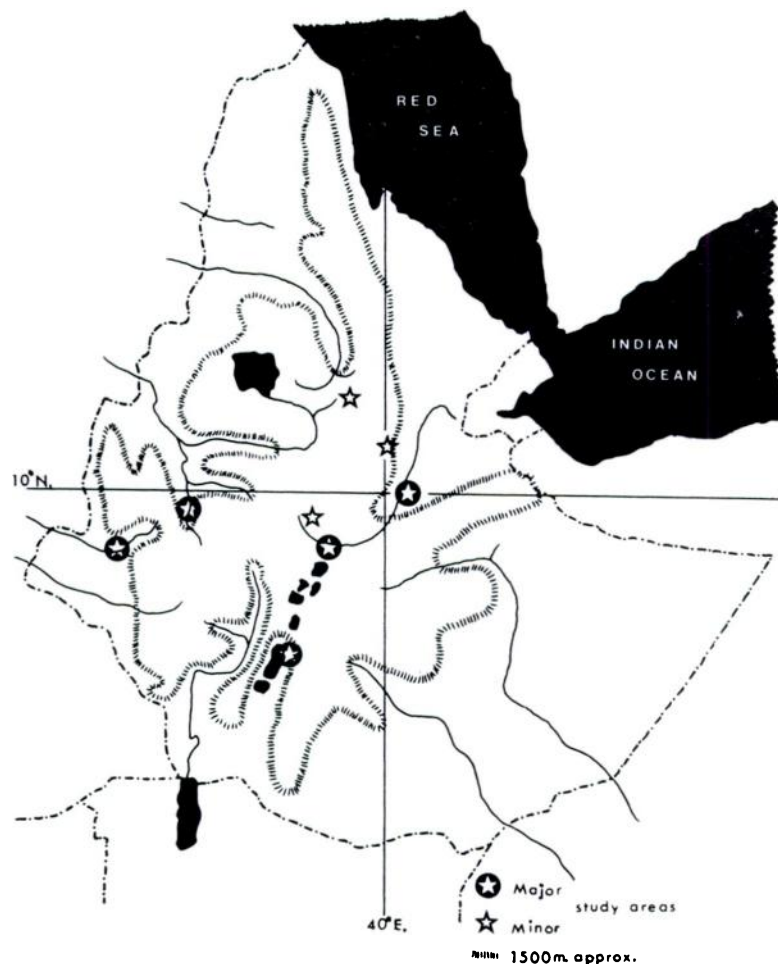


FIGURE 1. Map of Ethiopia showing areas from which blood smears were collected.

RESULTS

A total of 5046 smears from 352 species of birds were examined; this represents 43% of the species recorded from Ethiopia. The capture techniques resulted in a preponderance of passerines and near passerine orders. Altogether 1171 speci-

mens from 223 species had blood parasites, and 75 of the 85 species represented by 20 or more samples were positive. Parasitized bird species and their parasites identified to genus, are shown in Table 1. *Plasmodium* species are tabulated with their hosts in Table 2.

TABLE 1. Blood Infections of Ethiopian Birds

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
PELECANIFORMES									
Anhingidae									
<i>Anhinga rufa</i>						1	1	(17)	7
CICONIIFORMES									
Ardeidae									
<i>Ixobrychus minutus</i>	3	1	1				4	(44)	9
<i>Ardeola ralloides</i>	4				1		4	(22)	18
<i>Butorides striatus</i>			3				3	(60)	5
Totals:	7	1	4		1		11	(34)	32
Threskiornithidae									
<i>Bostrychia hagedash</i>	1						1	(100)	1
ANSERIFORMES									
Anatidae									
<i>Dendrocygna viduata</i>				6			6	(30)	20
<i>Alopochen aegyptiaca</i>	1						1	(6)	17
Totals:	1			6			7	(19)	37
FALCONIFORMES									
Accipiteridae									
<i>Elanus caeruleus</i>			1				1	(50)	2
<i>Milvus migrans</i>	3						3	(25)	12
<i>Necrosyrtes monachus</i>						1	1	(50)	2
<i>Melierax metabates</i>	1						1	(100)	1
<i>Melierax gabar</i>			1				1	(50)	2
<i>Accipiter minullus</i>			1				1	(33)	3
<i>Accipiter tachiro</i>	1		2				2	(67)	3
<i>Accipiter badius</i>			1				1	(100)	1
<i>Aquila rapax</i>	1						1	(50)	2
Totals	6		6			1	12	(43)	28

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
GALLIFORMES									
Phasianidae									
<i>Fringilla sephaena</i>		2	6				6	(60)	10
<i>Fringilla clappertoni</i>			6				6	(55)	11
<i>Fringilla squamatus</i>			1				1	(50)	2
Totals:		2	13				13	(57)	23
Numidae									
<i>Numida meleagris</i>	1	1	2				3	(50)	6
GRUIFORMES									
Rallidae									
<i>Porphyrio alleni</i>	2						2	(67)	3
CHARADRIIFORMES									
Jacanidae									
<i>Actophilornis africana</i>			2		1	2	4	(22)	18
Scolopacidae									
<i>Tringa glareola</i>	1						1	(4)	26
<i>Tringa hypoleucos</i>						1	1	(4)	25
<i>Gallinago gallinago</i>	1	1					1	(7)	14
Totals:	2	1				1	3	(5)	65
COLUMBIFORMES									
Columbidae									
<i>Columba guinea</i>	1					1	1	(100)	1
<i>Streptopelia turtur</i>	2						2	(40)	5
<i>Streptopelia semitorquata</i>	8		2		1		9	(39)	23
<i>Streptopelia decipiens</i>	21		2		3		22	(43)	51
<i>Streptopelia vinacea</i>	2						2	(100)	2
<i>Streptopelia capicola</i>	1						1	(10)	10
<i>Streptopelia senegalensis</i>	5		1				6	(27)	22
<i>Oena capensis</i>	5					4	8	(21)	38
<i>Turtur tympanistria</i>	7		1		1		7	(32)	22
<i>Turtur afer</i>	6		1				7	(16)	44
<i>Turtur chalcospilos</i>	2	1					3	(38)	8
<i>Turtur abyssinicus</i>	2		1				3	(100)	3
<i>Aplopelia larvata</i>	2		2			1	4	(22)	18
<i>Treron australis</i>	1						1	(33)	3
Totals:	65	1	10		5	6	76	(30)	250

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
CUCULIFORMES									
Cuculidae									
<i>Clamator jacobinus</i>	2					1	2	(100)	2
<i>Chrysococcyx caprius</i>			1				1	(8)	13
<i>Centropus monachus</i>			1				1	(33)	3
<i>Centropus superciliosus</i>	4		1				5	(26)	19
Totals:	6		3			1	9	(24)	37
STRIGIFORMES									
Tytonidae									
<i>Tyto alba</i>	2						2	(100)	2
Strigidae									
<i>Otus scops</i>	2		2				3	(75)	4
<i>Otus leucotis</i>	1					1	1	(100)	1
<i>Asio flammeus</i>			1				1	(100)	1
Totals:	3		3			1	5	(83)	6
CAPRIMULGIFORMES									
Caprimulgidae									
<i>Caprimulgus clarus</i>	1						1	(4)	28
CORACIIFORMES									
Alcedinidae									
<i>Ceryle rudis</i>	4						4	(14)	28
<i>Alcedo cristata</i>	2					1	2	(4)	50
<i>Ceyx picta</i>	1						1	(1)	68
<i>Halcyon senegalensis</i>						2	2	(5)	37
<i>Halcyon chelicuti</i>	3						3	(30)	10
<i>Halcyon leucocephala</i>					1	1	2	(6)	34
Totals:	10				1	4	14	(6)	227
Meropidae									
<i>Merops apiaster</i>						1	1	(100)	1
<i>Merops nubicus</i>	6					2	7	(30)	23
<i>Merops albicollis</i>	7	3				2	8	(67)	12
<i>Merops lafresnayii</i>					1	3	4	(21)	19
Totals:	13	3			1	8	20	(36)	55

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
Coraciidae									
<i>Coracias abyssinica</i>	4		1				4	(100)	4
<i>Eurystomus glaucurus</i>	1						1	(100)	1
Totals:	5		1				5	(100)	5
Upupidae									
<i>Upupa epops</i>		1				1	1	(4)	28
Bucerotidae									
<i>Tockus erythrorhynchus</i>	1						1	(50)	2
<i>Tockus albeterminatus</i>					1	1	1	(100)	1
Totals:	1				1	1	2	(67)	3
PICIFORMES									
Capitonidae									
<i>Lybius bidentatus</i>	1						1	(20)	5
<i>Lybius guifsobalito</i>	3						3	(10)	29
<i>Lybius undatus</i>	1						1	(20)	5
<i>Lybius leucomelas</i>	1		2			1	3	(23)	13
Totals:	6		2			1	8	(15)	52
Indicatoridae									
<i>Indicator variegatus</i>	1						1	(17)	6
<i>Indicator indicator</i>	2		1				3	(21)	14
<i>Indicator minor</i>			1				1	(6)	17
Totals:	3		2				5	(14)	37
Picidae									
<i>Jynx torquilla</i>	1		1				2	(14)	14
<i>Campethera nubica</i>	4		1				5	(23)	22
<i>Mesopicos goertae</i>			1				1	(11)	9
<i>Thripias namaguus</i>	1						1	(10)	10
Totals:	6		3				9	(16)	55
PASSERIFORMES									
Alaudidae									
<i>Eremopterix leucotis</i>	1						1	(9)	11

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
Hirundinidae									
<i>Riparia riparia</i>			1		1	1	3	(15)	20
<i>Riparia paludicola</i>	1		1		7	3	11	(16)	70
<i>Hirundo smithii</i>						1	1	(2)	45
<i>Hirundo aethiopica</i>	1						1	(17)	6
<i>Hirundo senegalensis</i>	2						2	(100)	2
<i>Hirundo abyssinica</i>					1		1	(7)	15
Totals:	4		2		9	5	19	(12)	158
Motacillidae									
<i>Motacilla flava</i>	13	5				1	17	(40)	43
<i>Motacilla alba</i>					1		1	(17)	6
<i>Anthus similis</i>		3					3	(23)	13
<i>Anthus trivialis</i>			1				1	(6)	16
<i>Anthus cervinus</i>	1		2				3	(23)	13
Totals:	14	8	3		1	1	25	(27)	91
Pycnonotidae									
<i>Pycnonotus barbatus</i>	17	11	19		4	10	40	(51)	78
<i>Chlorocichla flavicollis</i>			1		1		2	(29)	7
<i>Phyllastrephus strepitans</i>	3						3	(21)	14
Totals:	20	11	20		5	10	45	(45)	99
Laniidae									
<i>Prionops plumata</i>	1		1			1	2	(100)	2
<i>Nilaus afer</i>		1					1	(17)	6
<i>Dryoscopus gambensis</i>		3	2		1	4	7	(47)	15
<i>Tchagra minuta</i>	1	3	1		1	2	5	(100)	5
<i>Tchagra senegala</i>		2	3			3	5	(23)	22
<i>Laniarius aethiopicus</i>	6	6	1			2	12	(45)	22
<i>Laniarius erythrogaster</i>	2		1				2	(100)	2
<i>Laniarius funebris</i>	1	2	3				6	(43)	14
<i>Malaconotus sulfureopectus</i>	3	1					4	(29)	14
<i>Lanius collurio</i>	3						3	(17)	18
<i>Lanius nubicus</i>	1						1	(25)	4
Totals:	18	18	12		2	12	48	(39)	124

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
Muscicapidae									
<i>Saxicola rubetra</i>	1						1	(20)	5
<i>Cercomela familiaris</i>					1		1	(10)	10
<i>Myrmecocichla semirufa</i>	1		2				2	(67)	3
<i>Monticola rufocinerea</i>	1						1	(25)	4
<i>Phoenicurus phoenicurus</i>	4						4	(17)	24
<i>Cossypha semirufa</i>	4	4	1		1		8	(29)	28
<i>Cossypha heuglini</i>						1	1	(7)	14
<i>Luscinia megarhynchos</i>	3					1	4	(21)	19
<i>Luscinia luscinia</i>	9						9	(60)	15
<i>Turdus pelios</i>		19	18		5	18	38	(43)	89
<i>Turdoides leucopygius</i>	6	1	3		1		7	(88)	8
<i>Turdoides rubiginosus</i>	11				1	4	15	(52)	29
<i>Locustella luscinioides</i>		1					1	(8)	12
<i>Acrocephalus schoenobaenus</i>	1		1				1	(5)	20
<i>Acrocephalus scirpaceus</i>	10						10	(26)	39
<i>Acrocephalus arundinaceus</i>	3				1		4	(17)	24
<i>Acrocephalus baeticatus</i>	4						4	(67)	6
<i>Acrocephalus gracilirostris</i>	9	1			1	1	10	(83)	12
<i>Chloropeta natalensis</i>	3						3	(43)	7
<i>Sphenoeacus mentalis</i>			2			1	2	(40)	5
<i>Hippolais pallida</i>	17		2				18	(78)	23
<i>Sylvia nisoria</i>	8				2		8	(47)	17
<i>Sylvia borin</i>	6		5				8	(22)	37
<i>Sylvia atricapilla</i>	13		4			1	16	(32)	50
<i>Sylvia communis</i>	4	2					6	(19)	32
<i>Sylvia curruca</i>	5	1				1	7	(26)	27
<i>Sylvia mystacea</i>	1					1	2	(18)	11
<i>Phylloscopus trochilus</i>	6		1		1		8	(20)	41
<i>Phylloscopus collybita</i>			1		1		2	(8)	24
<i>Phylloscopus sibilatrix</i>	1						1	(100)	1
<i>Cisticola erythrops</i>	7	1	1		2	1	8	(22)	37
<i>Cisticola erythrops</i>						1	1	(2)	57
<i>Cisticola galactotes</i>	2	1	1				4	(50)	8
<i>Cisticola natalensis</i>	1	2					3	(21)	14
<i>Cisticola brachyptera</i>	4	1			3	2	8	(24)	34
<i>Prinia subflava</i>	4	6	1		2		9	(16)	55
<i>Phyllolais pulchella</i>	1					3	4	(20)	20
<i>Camaroptera brevicaudata</i>	3	1					4	(6)	67
<i>Eremomela icteropygialis</i>	1						1	(20)	5
<i>Eremomela canescens</i>	1						1	(25)	4
<i>Sylvietta brachyura</i>	2	2			1		4	(24)	17
<i>Sylvietta whytii</i>	8		1				8	(36)	22

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
<i>Muscicapa striata</i>	7					1	7	(88)	8
<i>Melaenornis edolioides</i>	6		2				6	(32)	19
<i>Bradornis pallidus</i>	12		1				12	(71)	17
<i>Hyliota flavigaster</i>	1						1	(33)	3
<i>Batis orientalis</i>		1	2				3	(25)	12
<i>Platysteira cyanea</i>					2		2	(13)	15
<i>Tersiphone viridis</i>		2	1		3	1	5	(13)	40
Totals:	191	46	50		28	38	293	(27)	1090
Paridae									
<i>Parus leucomelas</i>			1				1	(13)	8
Nectariniidae									
<i>Anthreptes orientalis</i>	1						1	(50)	2
<i>Anthreptes platurus</i>	4					1	5	(83)	6
<i>Nectarinia olivacea</i>	3		1				3	(27)	11
<i>Nectarinia senegalensis</i>	10		2			2	10	(77)	13
<i>Nectarinia venusta</i>					2		2	(29)	7
<i>Nectarinia habessinica</i>	12						12	(86)	14
<i>Nectarinia cuprea</i>		1					1	(4)	23
<i>Nectarinia pulchella</i>	1						1	(2)	47
Totals:	31	1	3		2	3	35	(28)	123
Zosteropidae									
<i>Zosterops abyssinica</i>	12				2		12	(92)	13
<i>Zosterops senegalensis</i>	9			1	2	3	10	(45)	22
Totals:	21			1	4	3	22	(63)	35
Emberizidae									
<i>Emberiza poliopleura</i>			1				1	(50)	2
<i>Emberiza tahapisi</i>							1	(10)	10
Totals:			1				1	(17)	12
Fringillidae									
<i>Serinus mozambicus</i>	32	1	7		9	5	39	(76)	51
<i>Serinus atrogularis</i>	4			1			5	(31)	16
<i>Serinus leucopygius</i>	2						2	(40)	5
<i>Serinus citrinelloides</i>	5		2		1	2	9	(32)	28
<i>Serinus nigriceps</i>		1	16				16	(70)	23
<i>Serinus striolatus</i>			2				2	(50)	4
<i>Serinus tristriatus</i>			4				4	(57)	7
Totals:	43	2	31	1	10	7	77	(57)	134

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
Estrildidae									
<i>Vidua paradisaea</i>			1				1	(25)	4
<i>Hypochoera chalybeata</i>					1	1	2	(20)	10
<i>Mandingoa nitidula</i>			1				1	(6)	16
<i>Amadina fasciata</i>					1		1	(14)	7
<i>Pytelia phoenicoptera</i>	11		1		3	2	12	(63)	19
<i>Estrilda paludicola</i>	16	1			1		17	(33)	51
<i>Estrilda rhodopyga</i>	1					1	2	(7)	28
<i>Estrilda astrild</i>	8	6			1	2	12	(80)	15
<i>Uraeginthus ianthinogaster</i>	1					1	1	(17)	6
<i>Uraeginthus bengalus</i>	14					2	14	(28)	50
<i>Lagonosticta larvata</i>	6		2		1	1	9	(39)	23
<i>Lagonosticta senegala</i>	4	1			2	3	8	(13)	63
<i>Lagonosticta rhodopareia</i>	3						3	(60)	5
<i>Lagonosticta rubricata</i>	7					1	8	(50)	16
<i>Lonchura malabarica</i>						1	1	(14)	7
<i>Lonchura fringilloides</i>	1						1	(33)	3
<i>Lonchura cucullata</i>	1				1		3	(6)	47
Totals:	73	8	5		11	15	96	(26)	370
Ploceidae									
<i>Amblyospiza albifrons</i>	1	1				1	3	(16)	19
<i>Ploceus baglafecht</i>	13	2	10				21	(64)	33
<i>Ploceus luteolus</i>	3				3	1	6	(15)	40
<i>Ploceus galbula</i>	13	8					20	(35)	57
<i>Ploceus taeniopterus</i>	1				1	1	2	(25)	8
<i>Ploceus intermedius</i>	2	2					3	(6)	47
<i>Ploceus velatus</i>	16	2				1	17	(59)	29
<i>Ploceus cucullatus</i>	29	8	2		2	2	35	(45)	78
<i>Ploceus rubiginosus</i>					1		1	(9)	11
<i>Ploceus superciliosus</i>		1	1				1	(5)	19
<i>Ploceus ocularis</i>		1	1		4	1	5	(13)	39
<i>Ploceus nigricollis</i>					1		1	(100)	1
<i>Malimbus rubriceps</i>	2		2			1	3	(100)	3
<i>Quelea erythrops</i>	9	9	2		1		20	(50)	40
<i>Quelea quelea</i>	8	2					10	(20)	50
<i>Euplectes afer</i>	4		1				5	(29)	17
<i>Euplectes albonotatus</i>	2						2	(14)	14
<i>Euplectes ardens</i>	14	3	2				17	(31)	55
<i>Euplectes axillaris</i>	4						4	(40)	10

TABLE 1 (Continued)

Name*	H	P	Lz	Lt	T	M	N	(%)	Total
<i>Euplectes gierowii</i>	3						3	(38)	8
<i>Euplectes hordeaceus</i>	9				1		10	(63)	16
<i>Euplectes macrourus</i>	5	4				1	9	(53)	17
<i>Euplectes franciscanus</i>	13	1					14	(21)	67
<i>Bubalornis niger</i>	1						1	(100)	1
<i>Dinemellia dinemelli</i>						1	1	(25)	4
<i>Plocepasser mahali</i>					2		2	(11)	19
<i>Passer griseus</i>	16	4	2		2	2	22	(32)	68
<i>Passer eminibey</i>	10	2	1		1	3	10	(59)	17
<i>Petronia pyrgita</i>	2		1				3	(43)	7
<i>Petronia dentata</i>	4	2					4	(33)	12
Totals:	184	52	25		19	15	255	(32)	806
Sturnidae									
<i>Lamprotornis chalybaeus</i>	2	1	2			1	7	(15)	48
<i>Spreo superbus</i>	2						3	(14)	21
<i>Creatophora cinerea</i>	17	2			1	1	19	(63)	30
Totals:	21	3	2		1	2	29	(29)	99
Oriolidae									
<i>Oriolus oriolus</i>	1		3				3	(100)	3
<i>Oriolus larvatus</i>		1	1				2	(100)	2
Totals:	1	1	4				5	(100)	5
Dicruridae									
<i>Dicrurus adsimilis</i>	3				1	2	5	(17)	29

*Name from Urban and Brown (1971)

H = *Haemoproteus*P = *Plasmodium*Lz = *Leucocytozoon*Lt = *Lankesterella*T = *Trypanosoma*

M = Microfilariae

N = Number of Birds Positive

Total = Total Number of Birds Checked

TABLE 2. Occurrence of Plasmodium Infections by Species.

	<i>relictum</i>	<i>vaughani</i>	<i>rouxi</i>	<i>nucleophilum</i>	<i>circumflexum</i>	<i>octamerium</i>	Miscellaneous
Ardeidae							
<i>Ixobrychus minutus</i>							1 sp.
Phasianidae							
<i>Francolinus sephaena</i>							2 <i>juxtannucleare</i>
Numidae							
<i>Numida meleagris</i>							1 <i>durae</i>
Scolopacidae							
<i>Gallinago gallinago</i>					1		
Columbidae							
<i>Turtur chalcospilos</i>		1					
Meropidae							
<i>Merops albicollis</i>		3					
Upupidae							
<i>Upupa epops</i>							1 <i>garnhami</i>
Motacillidae							
<i>Motacilla flava</i>	4				1		
<i>Anthus similis</i>	2						1 sp.
Pycnonotidae							
<i>Pycnonotus barbatus</i>	2		8				1 sp.
Laniidae							
<i>Nilaus afer</i>	1						
<i>Dryoscopus gambensis</i>	2		1				
<i>Tchagra minuta</i>		3					
<i>Tchagra senegala</i>		1	1				
<i>Laniarius aethiopicus</i>	1	4			1		
<i>Laniarius funebris</i>							2 sp.
<i>Malaconotus sulfureopectus</i>	1						
Muscicapidae							
<i>Cossypha semirufa</i>			4				
<i>Turdus pelios</i>	2	9	3				5 sp.
<i>Turdoides leucopygius</i>	1						
<i>Locustella luscinioides</i>	1						
<i>Acrocephalus gracilirostris</i>		1					
<i>Sylvia communis</i>	1						
<i>Sylvia communis</i>							1 sp.
<i>Cisticola erythrops</i>					1		
<i>Cisticola galactotes</i>			1				

TABLE 2 (Continued)

	<i>relictum</i>	<i>vaughani</i>	<i>rouxi</i>	<i>nucleophilum</i>	<i>circumflexum</i>	<i>octamerium</i>	Miscellaneous
<i>Cisticola natalensis</i>		1					1 <i>catheimerium</i>
<i>Cisticola brachyptera</i>	1						
<i>Prinia subflava</i>	5		1				
<i>Camaroptera brevicaudata</i>		1					
<i>Sylvietta brachyura</i>				1			1 sp.
<i>Batis orientalis</i>			1				
<i>Terpsiphone viridis</i>		1		1			
Nectariniidae							
<i>Nectarinia cuprea</i>		1					
Fringillidae							
<i>Serinus mozambicus</i>			1				
<i>Serinus nigriceps</i>	1						
Estrildidae							
<i>Estrilda paludicola</i>						1	
<i>Estrilda astrild</i>		3				3	
<i>Lagonosticta senegala</i>		1					
Ploceidae							
<i>Amblyospiza albifrons</i>		1					
<i>Ploceus baglafecht</i>			2				
<i>Ploceus galbula</i>	7			1			
<i>Ploceus intermedius</i>				2			
<i>Ploceus velatus</i>			1				1 sp.
<i>Ploceus cucullatus</i>	6	1		1			
<i>Ploceus superciliosus</i>		1					
<i>Ploceus ocularis</i>		1					
<i>Quelea erythrops</i>	8						1 sp.
<i>Quelea quelea</i>	1						1 sp.
<i>Euplectes ardens</i>			2				1 sp.
<i>Euplectes macrourus</i>		1	1			2	
<i>Euplectes franciscanus</i>			1				
<i>Passer griseus</i>	1	2					1 sp.
<i>Passer eminibey</i>	1	1					
<i>Petronia dentata</i>		2					
Sturnidae							
<i>Lamprotornis chalybaeus</i>	1						
<i>Creatophora cinerea</i>							2 sp.
Oriolidae							
<i>Oriolus larvatus</i>							1 sp.

Species which were represented over a wide geographical range were compared, and the different sites were compared by summing the results for common species. There was no difference discernible between the lowland localities, but the highland birds showed a much higher prevalence of *Leucocytozoon*. *Haemoproteus* was common, but less so in the highlands. *Trypanosoma*, *Plasmodium* and microfilariae were all of sporadic occurrence throughout. No meaningful seasonal comparisons can be made from the present data.

1. *Haemoproteus* species. With a single exception, no attempt has been made to identify specifically members of this genus. An occasional *Plasmodium* infection, which showed gametocytes only and resembled *Haemoproteus*, may have been included in this group. The exception is *H. enucleator* which has been described elsewhere,⁴ partly on the basis of an infection of this distinctive parasite in one of our 68 *Ceyx picta*.

At least two species were common in passerines in both lowlands and highlands, but were more prevalent in the former. There were no more than four or five distinguishable forms of passerines. *Nectarinia habessinica* was commonly infected with a distinctive form. There was also a parasite with distinctive female gametocytes in two highland thrushes, *Monticola rufocinerea* and *Myrmecocichla semirufa*. In non-passerines, *Bostrychia carunculata*, *Melierax metabates*, *Porphyrio alleni* and *Ceryle rudis* all had *Haemoproteus* infections with distinctive features, but full descriptions and species designation require life cycle studies.

Haemoproteus infections were rarely heavy, and none of the massive parasitaemias in Palaearctic migrants, seen for example in West Africa,¹ were recorded in this survey. The migratory warblers *Sylvinae* had similar prevalence and density of parasites as their sedentary relatives.

2. *Plasmodium* species. Approximately 12 *Plasmodium* species were distinguishable. Nine known species have been

satisfactorily identified, and three more are still under study.

Plasmodium relictum. Fifty infections of this species were found in 21 avian species but, in the absence of experimental infections, the determination is not conclusive.

Host list: *Motacilla flava* (Palearctic migrant), *Anthus similis*, *Pycnonotus barbatus*, *Nilais afer*, *Dryoscopus gambensis*, *Laniarius aethiopicus*, *Malaconotus sulfureopectus*, *Turdus pelios*, *Turdoides leucopygius*, *Locustella luscinioides* (Palearctic migrant), *Sylvia communis* (Palearctic migrant), *Cisticola brachyptera*, *Prinia subflava*, *Serinus nigricaps*, *Ploceus galbula*, *Ploceus cucullatus*, *Quelea erythropus*, *Quelea quelea*, *Passer eminibey*, *Lamprolornis chalybaeus*.

All infections were in passerines, and three of these were Palearctic migrants. The infected *Serinus nigricaps* was caught at 2,700 m.

Plasmodium cathemerium. This species was distinguished only once, in *Cisticola natalensis*.

Plasmodium vauhani. Differentiation between this species and *P. rouxi* was often a problem. Forty infections were identified in 21 host species.

Host list: *Turtur chalcospilos*, *Merops albicollis*, *Tchagra minuta*, *Tchagra senegala*, *Laniarius aethiopicus*, *Turdus pelios*, *Acrocephalus gracilirostris*, *Cisticola natalensis*, *Camaroptera brevicaudata*, *Terpsiphone viridis*, *Nectarinia cuprea*, *Estrilda astrild*, *Lagonosticta senegala*, *Amblyospiza albifrons*, *Ploceus cucullatus*, *Ploceus superciliosus*, *Ploceus ocularis*, *Euplectes macrourus*, *Passer eminibey*, *Petronia dentata*.

Plasmodium rouxi. Owing to the difficulty of distinguishing this species some infections may have been included with *P. vauhani*. Twenty-eight infections were diagnosed in 14 avian species.

Host list: *Pycnonotus barbatus*, *Dryoscopus gambensis*, *Tchagra senegala*, *Cosypha semirufa*, *Turdus pelios*, *Cisticola*

galactotes, *Prinia subflava*, *Batis orientalis*, *Serinus mozambicus*, *Ploceus baglafecht*, *Ploceus velatus*, *Euplectes ardens*, *Euplectes macrourus*, *Euplectes franciscanus*.

Plasmodium nucleophilum. Six infections were seen in five species. This parasite is clearly more common in Africa than the New World, to which it was once thought to be confined.

Host list: *Sylvietta brachyura*, *Terpsiphone viridis*, *Ploceus galbula*, *Ploceus intermedius*, *Ploceus cucullatus*.

Plasmodium juxtannucleare. Infections in two of ten *Fringilla sephaena* were identified as this species; the first wild host of this chicken parasite to be specifically identified in Africa, though previously it has been recorded¹² in two "partridges" *Fringilla* sp. in Tanzania.

Plasmodium circumflexum. Four infections in four hosts.

Host list: *Gallinago gallinago* (Palearctic migrant), *Motacilla flava* (Palearctic migrant), *Laniarius aethiopicus*, *Cisticola erythrops*.

Plasmodium octamerium. Six infections in three hosts.

Host list: *Estrilda paludicola*, *Estrilda astrild*, *Euplectes macrourus*.

This parasite was described¹⁰ from a canary which had been inoculated with blood from *Vidua macroura* of unknown origin. These records are thus the first from wild birds. All three species are marsh-loving, and may associate with *V. macroura*. None of 26 *V. macroura* was infected with blood parasites.

Plasmodium garnhami. A single infection was found in 28 *Upupa epops* examined. This is the first record of the *U. epops* malaria outside Egypt from where it was originally described.⁹

Plasmodium durae. A single *Numida meleagris* of the six examined was infected with this parasite, establishing for

the first time a wild African reservoir for this important pathogen of domestic turkeys.

Plasmodium sp. Most of the unidentified malaria parasites are in very low infections, or at too early a stage of development to be identifiable. Distinctive infections from *Ixobrychus minutus*, *Turdus pelios*, and two from *Creatophora cinerea*, are still under study.

Plasmodium juxtannucleare and *P. garnhami* and possibly *P. durae* are thought to be stenoxenous parasites. Of the others, *P. octamerium* appears to favour marsh-loving passerines, but there are no discernible trends or preferences in the other species. During the vertebrate blood-stage of their life cycles there seems to be almost complete ecological overlap, and no correlation exists between *Plasmodium* infection and migratory status, habitat, nesting habits, abundance, feeding habits or brightness of plumage. A few host species are conspicuously favourable, however: *Pycnonotus barbatus*, *Turdus pelios*, and the shrike family Laniidae, seven members of which are hosts to four species of *Plasmodium*.

3. *Leucocytozoon* spp. Parasites of this genus which was not distinguished from *Akiba* occurred only sporadically in the lowlands. *Pycnonotus barbatus*, *Turdus pelios* and species of Galliformes were the only regular lowland hosts. The parasites were all of the round form except in the single *Melierax metabates* which had a heavy infection of spindle-shaped gametocytes. In the highlands *Leucocytozoon* was common and widespread. *Serinus nigriceps*, *Serinus striolatus*, *Serinus tristriatus* and *Ploceus baglafecht* were commonly infected by a parasite which appeared the same in all hosts, producing large round gametocytes. This species is under further study.

4. *Lankesterella*. Among passerines three individuals of three species harboured this parasite. Although it might have been overlooked, its occurrence in Ethiopia seems to be surprisingly rare.

None of the infections were in a migrant. The *Lankesterella* of *Dendrocygna viduata* is distinctive in inhabiting erythrocytes alone.

5. *Trypanosoma*. No attempt has been made to identify these pleomorphic parasites specifically. They were less commonly found than any other parasite except *Lankesterella*, and were mostly in very low parasitemias. One *Cisticola erythrops*, one *Hirundo abyssinica* and some of the seven infected *Riparia paludicola*, however, had heavy infections. No dividing forms were found in any of the blood smears.

6. *Microfilariae*. The many forms of microfilariae seen were sporadically distributed, and only *Turdus pelios* was consistently positive. Both sheathed and non-sheathed types were found. The slides have been forwarded to the WHO Reference Centre, for further study.

Bird species in which no blood parasites were seen and the number of birds examined in each species are noted in the following list: PELECANIFORMES—*Phalacrocorax carbo* (1); CICONIIFORMES—*Ardeola ibis* (11); *Egretta alba* (2); *Egretta intermedia* (1); *Ardea cinerea* (1); *Scopus umbretta* (2); *Botrychus carunculata* (2); *Plegadis falcinellus* (2); *Phoenicopiterus ruber* (7); ANSERIFORMES—*Dendrocygna bicolor* (4); *Anas capensis* (6); *Anas undulata* (3); *Anas acuta* (3); *Anas hottentota* (5); *Anas querquedula* (5); FALCONIFORMES—*Aviceda cuculoides* (1); *Neophron percnopterus* (1); *Gyps ruppellii* (1); *Circus macrourus* (3); *Circus pygargus* (1); *Buteo rufofuscus* (1); *Lophoaelus occipitalis* (1); *Falco ardosiacus* (1); *Falco chicquera* (1); *Falco peregrinus* (1); GALLIFORMES—*Coturnix coturnix* (1); GRUIFORMES—*Turnix sylvatica* (1); *Rallus rougetii* (3); CHARADRIIFORMES—*Rostratula benghalensis* (1); *Vanellus spinosus* (38); *Charadrius hiaticula* (10); *Charadrius dubius* (15); *Charadrius pecuarius* (22); *Charadrius tricollaris* (10); *Charadrius alexandrinus* (3); *Charadrius mongolus* (1); *Limosa limosa* (1); *Tringa nebularia* (9); *Tringa stagnatilis* (22); *Tringa ochropus* (10); *Tringa totanus* (9); *Tringa terek* (1);

CHARADRIIFORMES—*Arenaria interpres* (1); *Gallinago nigripennis* (4); *Gallinago minima* (1); *Calidris ferruginea* (14); *Calidris minuta* (21); *Calidris temminckii* (11); *Philomachus pugnax* (15); *Himantopus himantopus* (11); *Recurvirostra avosetta* (4); *Burhinus senegalensis* (3); *Sterna nilotica* (1); COLUMBIFORMES—*Columba albitorques* (1); *Streptopelia lugens* (2); *Treron walia* (11); PSITTACIFORMES—*Agapornis taranta* (3); CUCULIFORMES—*Clamator glandarius* (1); *Cuculus canorus* (1); *Chrysococcyx klaas* (11); CAPRIMULGIFORMES—*Caprimulgus europaeus* (7); *Caprimulgus aegyptius* (1); *Caprimulgus rufigena* (1); *Caprimulgus poliocephalus* (1); *Caprimulgus inornatus* (2); *Caprimulgus climacurus* (1); *Macrodipteryx longipennis* (3); COLIIFORMES—*Colius striatus* (33); *Colius macrourus* (4); CORACIIFORMES—*Alcedo semitorquata* (6); *Merops superciliosus* (2); *Merops pusillus* (55); *Phoeniculus purpureus* (5); *Tockus deckeni* (3); PICIFORMES—*Lybius melanoccephalus* (1); *Pogoniulus pusillas* (18); *Pogoniulus chrysoconus* (3); *Trachyphonus erythrocephalus* (2); *Prodotiscus regulus* (1); *Campethera cailliautii* (2); *Dendropicos fuscescens* (9); *Dendropicos abyssinicus* (1); PASSERIFORMES—*Mirafra rufocinnamomea* (1); *Hirundo rustica* (31); *Hirundo daurica* (9); *Psallidoprocne pristoptera* (8); *Motacilla alba* (3); *Anthus novaeseelandiae* (2); *Anthus leucophrys* (15); *Campephaga phoenicea* (3); *Eurocephalus ruppelli* (3); *Malacotus blanchoti* (2); *Lanius excubitorius* (19); *Lanius dorsalis* (2); *Lanius collaris* (7); *Lanius senator* (2); *Saxicola torquata* (13); *Oenanthe oenanthe* (3); *Oenanthe pleschanka* (7); *Oenanthe isabellina* (14); *Oenanthe bottae* (1); *Myrmecocichla cinnamomeiventris* (1); *Cossypha natalensis* (15); *Cossypha niveicapilla* (8); *Luscinia svecica* (8); *Turdus olivaceus* (3); *Turdus piaggiae* (1); *Alcippe abyssinica* (1); *Bradypterus baboecala* (1); *Locustella fluviatilis* (5); *Acrocephalus palustris* (2); *Cisticola juncidis* (4); *Heliolais erythroptera* (2); *Muscicapa adjusta* (1); *Bradornis microhynchus* (1); *Batis minor* (4); *Anthreptes*

collaris (17); *Nectarinia mariquensis* (24); *Nectarinia tacazze* (1); *Emberiza hortulana* (1); *Serinus dorsostriatus* (10); *Vidua macroura* (26); *Amandava subflava* (4); *Onychognathus morio* (1); *Onychognathus albirostris* (3); *Lamprolornis purpuropterus* (27); *Cinnyricinclus sharpii* (1); *Buphagus erythrorhynchus* (13); *Corvus crassirostris* (5); *Gallus domesticus* (11).

DISCUSSION

The specimens examined in this study provide baseline data with which to compare past and future work. The presence of a large and varied bird blood fauna in Ethiopia has been established, with at least 22 parasite species occurring. Only 40%, however, of the avian species known to occur in Ethiopia are represented, and only 10% of these by samples of 20 or more individuals.

Among previous studies in East Africa, a parasite distribution similar to that of the present study was found in an unspecified sample of Kenyan birds.⁷ Also, comparable rates were found in 31 species of birds in northern Kenya, with babblers, bulbuls and wood doves having a high prevalence of infection.¹⁴

There is no indication of what controls the various host ranges, which, except in the case of stenoxenous parasites, show no obvious rationale. There is a wide host range in the case of the more common *Plasmodium* species, but only a low prevalence in any particular host species. It seems that these species are dependent on a wide range of hosts with no main host maintaining the parasite. The few bird species which are outstandingly good or poor hosts to haematozoa deserve detailed comparison regarding their habits, habitats and blood chemistry.

Acknowledgements

The authors gratefully acknowledge the considerable help in initial screening of blood-smears undertaken by Waka Asfaha, Tadesse Chane, L. B. Townley and Mesfin Yigzaw. Drs. E. McConnell and C. K. Wallace read earlier drafts of the paper and made valuable suggestions for its improvement.

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Received for publication 15 October 1974