

## Blood Parasites of Birds from Almirante, Panama with ecological notes on the hosts\*

by

Pedro Galindo\*\* and Octavio Sousa\*\*

(Received for publication January 5, 1966)

There have been few comprehensive surveys of blood parasites of neotropical birds. The only published information on the subject from Panama and surrounding areas is that by RENJIFO *et al.* (5) and TAKOS (6). Both of these surveys were limited in their scope as the samples were small and only a relatively low percentage of the species of the local avifauna was included.

As part of a general survey for arthropod-borne viruses in a tropical rain-forest area of Panama, large numbers of birds were captured and bled between 1960 and 1963. A thin smear from each bird collected was prepared to be used for blood parasite studies. In this manner, over 3,500 individual smears were obtained. The present publication presents an annotated list of the avian species sampled during the survey and a general account of the main groups of blood parasites found in each species of bird. Plans have been drawn to have this publication followed by additional reports covering parasitological studies conducted on several species of *Plasmodium* isolated during the survey.

### DESCRIPTION OF THE STUDY AREA

The study area surrounds the town of Almirante, between the Changuinola and Western Rivers, in extreme northwestern Panama. It extends from the sea shore to 3,000 ft. above sea level. The area has a tropical rain forest climate and, as a consequence, is mainly covered by evergreen broad-leaf forest. This apparently homogeneous type of vegetation actually is composed of a number of ecological associations which have developed under the influence of special

---

\* This work was supported in part by Grant AI-02984 from the National Institute of Allergy and Infectious Diseases.

\*\* Gorgas Memorial Laboratory, Apartado 6991, Panama, R. of P.

orographic, hydrographic and edaphic conditions or of human activity. The main types of ecological associations sampled for birds were: 1) swamp forests; 2) open fresh water marshes; 3) upland tropical rain forest; 4) peridomestic and second-growth associations. Collecting sites were selected at or near sea level in the general vicinity of Almirante with the exception of the Changuena station which is located deep within an upland tropical rain forest between 2,500 and 3,000 ft. above sea level about 40 kms to the southwest of Almirante. GALINDO *et al.* (3) give a more complete ecological description of the study area and of the sites where collections of birds were carried out.

## METHODS

In the arbovirus survey, birds that were to be sacrificed were bled from the heart without the use of an anticoagulant, while those to be banded and released were bled from the external jugular vein using heparin as anticoagulant. In the first case the thin smear was prepared by placing on a slide a drop of blood from the syringe, while in birds to be banded, blood was obtained by pricking a leg vein before drawing the sample from the jugular vein. At the end of daily activities all smears obtained that day were fixed for one minute in absolute methyl alcohol. Slides were shipped by air from the field station to the laboratory in Panama City twice a week. All slides were numbered with a diamond pencil at the time the slide was prepared. In the case of banded specimens, the number of the band was written on the slide. When birds were sacrificed as museum specimens, the number of the specimen label was used. At the laboratory, slides were stained with Giemsa by conventional methods. Every smear was examined under an oil-immersion objective and a 6× ocular for at least 10 minutes before discarding it as negative. Most positive slides were examined for longer periods in search of mixed infections or of additional stages of the parasite in case of *Plasmodium* infections.

## RESULTS

A total of 3,634 blood smears representing 249 species, 48 families and 19 orders of birds was examined during the survey. Results are summarized in Table 1. As may be noted 926 smears, or 25.5% of the sample, were found positive for blood parasites. The commonest of the groups of parasites found was *Haemoproteus*, followed by *Plasmodium*, microfilariae, trypanosomes and *Leucocytozoon*.

Table 2 presents a breakdown by avian families of the types of blood parasites found in passerine birds. It will be noted that there were some families, like Thraupidae and Cotingidae, which exhibited very high infection rates. It may be observed also that *Plasmodium* and *Haemoproteus* infections were more prevalent in highly specialized families, such as Icteridae, Thraupidae and Fringillidae, while trypanosome infections appeared more frequently in the more

TABLE 1.

*Types of blood parasites found by orders of birds*

Order	No. of species examined	Blood smears			Types of parasites				
		Smears examined	Total positive	% positive	Plasmodium	Haemoproteus	Leucocytozoor	Trypanosoma	Microfilaria
Tinamiformes	2	18	2	11.1		1		1	
Columbiformes	1	3							
Pelecaniformes	3	4							
Ciconiiformes	11	74	8	10.8	5		2	1	1
Anseriformes	1	4							
Falconiformes	15	42	12	28.6	3	8			1
Galliformes	3	7	6	85.7		6		2	
Gruiformes	4	41	1	2.4	1				
Charadriiformes	4	16	1	6.3	1				
Columbiformes	10	182	62	34.1	4	56			4
Psittaciformes	6	120	24	20.0	4	5			20
Cuculiformes	3	76	16	21.1	2				16
Strigiformes	2	4	4	100.0		4			1
Caprimulgiformes	3	6	1	16.7		1		1	
Apodiformes	7	108	1	0.9		1			
Trogoniformes	4	28	7	25.0		3			5
Coraciiformes	4	26	6	23.1				3	5
Piciformes	15	188	37	19.7	15	3		3	23
Passeriformes	151	2687	738	27.5	198	501	16	50	148
Totals	249	3634	926	25.5	233	589	18	61	224

primitive groups such as Cotingidae and Tyrannidae.

**TYPES OF PARASITES** — No special effort was made to study specifically *Haemoproteus* and trypanosomes observed. However, a careful study was carried out with *Plasmodium* and microfilariae infection in an attempt to identify them to species. Of the 233 positive smears for *Plasmodium*, 16 could not be placed beyond the generic limits because of the lack of stages of the parasite showing key characters. The remaining 217 infections were found to belong to 10 distinct morphological types. Seven of these types corresponded closely to the morphology of known species, while three did not seem to agree with any of the described avian plasmodia. These unknown types are referred to in this reports as "Butorides" "Casmerodius" and "Piaya" plasmodia, according to the generic name of the host. Following is a list of the morphological types of *Plasmodium* observed during the survey, together with the number of infections of each type. *Plasmodium relictum* (22), *P. cathemerium* (15), *P. polare* (2), *P. hexamerium* (= *oti*, MANWELL, 4) (105), *P. vaughani* (165), *P. circumflexum* (9), *P. nucleophilum* (7), "Butorides" (3), "Casmerodius" (1), "Piaya" (2).

TABLE 2.

*Types of blood parasites found by families of passerine birds*

Avian families	No. of species examined	Blood smears			Types of parasites				
		Smears examined	Total positive	% positive	Plasmodium	Haemoproteus	Leucocytozoon	Trypanosoma	Microfilaria
Dendrocolaptidae	9	44	2	4.5					2
Furnariidae	5	43	3	6.9	1	1		2	1
Formicariidae	16	37	6	16.2	2			2	2
Cotingidae	10	63	25	39.7	4	1		19	15
Pipridae	3	46	4	8.7	1	2			2
Tyrannidae	20	271	42	15.5	5	21	1	8	16
Hirundinidae	3	88	5	5.7	2		2		1
Corvidae	1	1							
Troglodytidae	7	50	2	4.0	1				1
Mimidae	1	29	1	3.4					1
Turdidae	8	203	28	13.8	3	5	10	3	11
Sylviidae	1	1							
Vireonidae	2	6	2	33.3		1	1	1	
Coerebidae	4	20	2	5.0	1				2
Parulidae	18	77	9	11.7	2	2	1	3	1
Icteridae	9	70	14	20.0	10	2	1	1	5
Thraupidae	19	890	471	52.9	116	405		11	64
Fringillidae	15	723	119	16.5	50	59			23
Unidentified		25	3			2			1
Totals	151	2687	738	27.5	198	501	16	50	148

ADAMES (1) made a detailed study of 134 blood smears containing microfilariae taken early in the survey. He described 12 distinct morphological types, two of which corresponded closely to already known species, namely, *Splendidofilaria webri* Anderson and *Pseudaproctella inornata* Anderson, described from Swainson's Thrush (*Hylocichla ustulata*) and the Wood Thrush (*Hylocichla mustelina*) respectively. These two species of filaria were found in our study area in migrating specimens of the original host species.

*Leucocytozoon* infections were rarely encountered and 12 of the 18 positive specimens belong to northern species captured during migration. The six local infections of *Leucocytozoon* detected corresponded to birds belonging to four different families, namely, a heron, a swallow, a flycatcher and an oriole.

#### ANNOTATED LIST OF BIRDS FOUND POSITIVE

The following species of birds were found to harbor blood parasites. Scientific and common names are those currently accepted by Dr. Alexander Wetmore (personal communication).

## TINAMIDAE (Tinamous)

*Tinamus major* (Great Tinamou) - This inhabitant of virgin forest was formerly common around Almirante but is becoming rare as human activity expands. Three specimens were examined, two of which were found infected, one with *Haemoproteus* and one with trypanosomes.

## ARDEIDAE (Herons and Egrets)

*Butorides virescens* (Green Heron) - This is a common inhabitant of the lowland swamps near Almirante. Twenty-three smears were examined, 6 of which, or 26.1%, showed blood parasites. Three of the 6 showed infections with an undescribed species of *Plasmodium* ("Butorides" type), 2 specimens harbored *Leucocytozoon* and there were single infections of trypanosomes and microfilarias. The *Plasmodium* infection was studied in naturally infected nestlings and will be the subject of a separate publication.

*Casmerodius albus* (Common Egret) - Thirty-one specimens examined revealed a single positive smear with an undetermined species of *Plasmodium* ("Casmerodius" type) close to but apparently different from *P. circumflexum*.

## CICONIIDAE (Storks)

*Mycteria americana* (Wood Ibis) - This species of stork was observed but once during 3 years. A group of 5 was found roosting high above a fresh water swamp. One of these birds was shot and found infected with a *Plasmodium* morphologically similar to *P. hexamerium*.

## CATHARTIDAE (American Vultures)

*Cathartes aura* (Turkey Vulture) - Seen only during migratory flights in fall and spring and mainly a migrant in Almirante. On the evening of April 2, 1962 a large flight was seen coming in from the southeast and dropping down to roost for the night on the tall branches of a grove of *Ficus* trees at the edge of town. Next morning 4 birds were captured and bled. All of these specimens were found to harbor hemoparasites. Three were infected with a species of *Haemoproteus* and 1 with a microfilaria. Three additional birds of this species captured at other times were negative for blood parasites.

## ACCIPITRIDAE (Hawks, Eagles, and allies)

*Buteo platypterus* (Broad-winged Hawk) - A common winter visitant in Almirante. Juveniles often remain behind during the summer after adults leave for the north. Fifteen smears were examined and 5 were found positive. Three had *Haemoproteus* and 2 harbored an undetermined *Plasmodium*.

*Ictinia plumbea* (Plumbeous Kite) - The only specimen examined was positive with a *Plasmodium* much like *P. hexamerium*.

## FALCONIDAE (Falcons)

*Micrastur ruficollis* (Barred Forest-Falcon) - Two specimens examined were found infected with *Haemoproteus*.

## CRACIDAE (Guans and Curassows)

*Penelope purpurascens* (Crested Guan) - This is a common species in virgin tropical rain forest in Panama but is rarely seen around Almirante. Specimens reported were taken in the Changuena area. Four smears were examined, all of which showed blood parasites. One had a mixed infection of *Haemoproteus* and trypanosomes, the other 3 showed gametocytes of *Haemoproteus*.

*Ortalis cinereiceps* (Gray-headed-Chachalaca) - Although fairly common around the edges of swamps in the vicinity of Almirante, they are very wary and only 2 specimens were captured. A blood smear of one showed a mixed infection of *Haemoproteus* and trypanosomes. The other had *Haemoproteus* gametocytes.

## RALLIDAE (Rails)

*Aramides cajanea* (Gray-necked Wood-Rail) - Common around the edges of swamps in Almirante. Only 1 out of 9 smears examined showed hemoparasites, it being a *Plasmodium* infection of the *P. vaughani* type.

## SCOLOPACIDAE (Sandpipers)

*Tringa solitaria* (Solitary Sandpiper) - One out of 11 specimens of this winter visitant was found infected with a *Plasmodium vaughani*-like parasite.

## COLUMBIDAE (Pigeons and Doves)

*Claravis pretiosa* (Blue Ground-Dove) - A common inhabitant of second-growth thickets in Almirante. Of 37 specimens examined, 14 were found infected with a species of *Haemoproteus* and 1 with a *P. vaughani*-like parasite.

*Columba cayennensis* (Pale-vented Pigeon) - A very common pigeon in the mangrove swamps near Almirante. Specimens are often seen also in second growth thickets near the coast. Five out of 38 smears showed blood parasites. Three had *Haemoproteus* gametocytes, 1 a *Plasmodium relictum*-like parasite and 1 microfilariae.

*Columba nigrirostris* (Short-billed Pigeon) - The preferred habitat of this species is virgin tropical rain forest, but in the Almirante area it is often seen along the forest edge and in second growth. Out of 22 specimens examined, 10 had *Haemoproteus* gametocytes in the blood. One of these was found to be a mixed infection showing also microfilariae and a *Plasmodium relictum*-like organism.

*Columba speciosa* (Scaled Pigeon) - Not infrequently seen around edges of forest and of thick second growth in the vicinity of Almirante. Nine blood smears were examined and 4 had *Haemoproteus* gametocytes.

*Columbigallina talpacoti* (Ruddy Ground-Dove) - Commonest of the Columbidae in Almirante, frequently encountered in second growth thickets, open fields and fruit orchards. Fifty-seven specimens were examined, 24 of which were positive. Of these, 23 harbored *Haemoproteus*, 1 had *Plasmodium* and 2 showed microfilariae.

*Geotrygon laurencii* (Lawrence's Quail-Dove) - This species occurs in upland tropical rain forest. Two specimens were obtained in the Changuena area both of which showed microfilariae in the blood.

*Leptotila verreauxi* (White-fronted Dove) - An inhabitant of open areas and rather uncommon around Almirante. Fourteen specimens were examined and 1 was found with *Haemoproteus*.

*Zenaidura macroura* (Mourning Dove) - A migrant from the north rarely seen in Almirante. A single specimen examined was found harboring *Haemoproteus*.

#### PSITTACIDAE (Parrots and Macaws)

*Pionopsitta haematotis* (Red-eared Parrot) - Large flocks of this small parrot are commonly seen along the edges of forest. Out of 49 smears examined 21 showed blood parasites. Of these, 19 were found with microfilariae, 2 with *Haemoproteus* and 3 with a *Plasmodium nucleophilum*-like parasite.

*Pionus menstruus* (Blue-headed Parrot) - A common parrot in the Almirante area. Forty-five specimens were examined for blood parasites and only 3 were positive. All of these positive smears showed *Haemoproteus* gametocytes, 1 being a mixed infection also harboring microfilariae and *Plasmodium circumflexum*-like parasites.

#### CUCULIDAE (Cuckoos and Anis)

*Crotophaga sulcirostris* (Groove-billed Ani) - Common in grassy fields in the outskirts of Almirante. Out of 44 specimens examined the only positive was a heavy microfilaria infection.

*Piaya cayana* (Squirrel Cuckoo) - Common along the forest edge. Thirty one specimens were examined and 15 had microfilariae. Two of these also revealed an undetermined species of *Plasmodium* ("Piaya" type).

#### STRIGIDAE (Owls)

*Otus guatemalae* (Vermiculated Screech Owl) - Two specimens from the Changuena area showed *Haemoproteus* gametocytes.

*Pulsatrix perspicillata* (Spectacled Owl) - Two specimens were examined, of which 1 had *Haemoproteus* and the other a mixed infection of *Haemoproteus* and microfilariae.

#### CAPRIMULGIDAE (Goatsuckers and Nightjars)

*Chordeiles minor* (Common Nighthawk) - A migrant from the north which also breeds on the Pacific slopes of Panama. On the evening of September 16, 1962 a large flight was observed coming into Almirante. A flock of birds

from this flight came in low over our field station and remained until dark busily capturing winged termites. A single specimen shot on the wing showed a mixed infection of *Haemoproteus* and trypanosomes.

#### TROCHILIDAE (Hummingbirds)

*Threnetes ruckeri* (Rucker's Hermit) - The only species of hummingbird found infected with blood parasites during the survey. Of 12 specimens examined 1 was found with *Haemoproteus*.

#### TROGONIDAE (Trogons)

*Trogon clathratus* (Lattice-tailed Trogon) - Nine specimens were collected during the study period all from the Changuena region. Two of the smears examined had microfilariae, 1 had *Haemoproteus* and 1 a mixed *Haemoproteus*-microfilariae infection.

*Trogon violaceus* (Gartered Trogon) - A fairly common species in the lowland woods near Almirante. Of 9 specimens examined 2 were found infected with microfilariae and 1 with *Haemoproteus*.

#### MOMOTIDAE (Motmots)

*Baryphthengus martii* (Rufous Motmots) - Six out of 7 specimens examined were found infected. Three showed microfilariae, 1 trypanosomes and 2 mixed infections of trypanosomes and microfilariae.

#### BUCCONIDAE (Puffbirds)

*Malacoptila panamensis* (White-whiskered Puffbird) - Commonest of the puffbirds in Almirante. Three out of 12 specimens showed microfilariae.

*Notharcus macrorhynchus* (White-necked Puffbird) - Five smears were examined resulting in the detection of 2 single infections of *Haemoproteus* and 1 mixed infection of microfilariae and a *Plasmodium relictum*-like parasite.

#### RAMPHASTIDAE (Toucans)

*Pteroglossus torquatus* (Collared Aracari) - Very common in Almirante. Thirty four specimens were examined 4 of which were found with microfilariae

*Ramphastos sulfuratus* (Keel-billed Toucan) - Commonest of the toucans in the woods near Almirante. A total of 35 birds was examined and 19 were positive. Thirteen were found harboring a *Plasmodium* resembling morphologically *P. vaughani* 10 had microfilariae and 1 specimen each was found with trypanosomes and *Haemoproteus*.

*Ramphastos swainsonii* (Swainson's Toucan) - Seen together with the Keel-billed Toucan, but in lesser numbers, in the lowland forests near Almirante. Eight smears were examined 3 of which showed blood parasites. Two had trypanosomes and 1 microfilariae.

*Selenidera spectabilis* (Cassin's Aracari) - Very rare in the woods near Almirante. Two specimens were examined 1 of which was found harboring microfilariae.



## PICIDAE (Woodpeckers)

*Centurus pucherani* (Pucheran's Woodpecker) - Commonest of the woodpeckers in the study area. It prefers the edges of forest and old rotting trees in pastures. A total of 56 smears was examined and a single *Plasmodium nucleophilum*-like infection was found.

*Pbloeoceastes guatemalensis* (Flint-billed Woodpecker) - Commonest of the large species of woodpeckers with a conspicuous red crest. Two smears out of 18 were found to have microfilariae.

*Dryocopus lineatus* (Lineated Woodpecker) - Rarer and more secluded than the preceding species, found mainly in primary forest. Four specimens were examined and 1 had microfilariae.

## DENDROCOLAPTIDAE (Woodhewers)

*Dendrocolaptes certhia* (Barred Woodhewers) - This large species is an inhabitant of upland tropical rainforest. Four specimens were captured in the Changuena area and 1 was found positive for microfilariae.

*Lepidocolaptes souleyetii* (Streak-headed Woodhewer) - Commonest of the woodhewers in the lowlands of Almirante. One out of 16 smears revealed an infection with microfilariae.

## FURNARIIDAE (Ovenbirds)

*Automolus ochrolaemus* (Buff-throated Automolus) - An inhabitant of the deep forest occurring in both swamp and upland forest. Three specimens were obtained in the Changuena area, 1 of which was found to harbor an unidentified species of *Plasmodium*.

*Synallaxis brachyura* (Slaty spinetail) - A very common bird in the lowlands of Almirante. Two out of 34 specimens showed blood parasites. One had trypanosomes and the other a mixed *Haemoproteus*-trypanosomes-microfilariae infection.

## FORMICARIIDAE (Antbirds)

*Cercomacra tyrannina* (Tyrannine Antbird) - An inhabitant of densely wooded areas. Five specimens were captured in Changuena, 1 of which had trypanosomes.

*Cymbilaimus fasciatus* (Fasciated Antshrike) - Not infrequently seen along the edges of clearings in upland tropical rain forest. Three smears were examined and 1 was found positive for trypanosomes.

*Dysithamnus mentalis* (Plain Antvireo) - This species occurs in the upper canopy of upland tropical rain forests frequenting the edge of forest clearings. One out of 3 smears obtained in the Changuena area showed microfilariae.

*Formicarius analis* (Black-faced Antthrush) - Also an inhabitant of upland forests, but in contrast to former species it is usually seen in shrubbery near

the forest floor. A single specimen captured in Changuena had microfilariae in the blood.

*Grallaria guatemalensis* (Scaled Antpitta) - All Antpittas in Panama are inhabitants of upland tropical rain forest moving not far above the forest floor. The single smear of this species examined showed an unidentified *Plasmodium* infection.

*Grallaricula flavirostris* (Common Pygmy Antpitta) - Two specimens were taken in the Changuena forest, 1 of which exhibited parasites much like *Plasmodium nucleophilum*.

#### COTINGIDAE (Cotingas)

*Attila spadiceus* (Yellow-rumped Attila) - A rather rare inhabitant of the lowland forests near Almirante. The single smear of this species examined had microfilariae.

*Carpodectes nitidus* (Snowy Cotinga) - This beautiful bird can be frequently seen high up in the upper canopy of trees along the edges of swamp forests in Almirante. Four out of 7 specimens examined showed blood parasites. Two had trypanosomes and 2 microfilariae.

*Erator inquisitor* (Black-crowned Tityra) - This is the commonest of the Cotingas around Almirante occurring along the edges of forest swamps in the upper branches of trees. Of 18 specimens examined, there were 13 positive for blood parasites. Eleven showed trypanosomes, 8 had microfilariae and 1 exhibited gametocytes of *Haemoproteus*.

*Pachyrhamphus cinnamomeus* (Cinnamon Becard) - This species is less arboreal than other Cotingas and is commonly seen in low cacao trees. Three of 7 specimens showed blood parasites. All 3 were infected with a *Plasmodium* similar to *P. circumflexum* mixed with a trypanosome infection. Two of them also exhibited microfilariae.

*Pachyrhamphus polychropterus* (White-winged Becard) - Rarely seen in the forests of Almirante. A single specimen examined showed a mixed *Plasmodium*-trypanosome-microfilaria infection.

*Querula purpurata* (Purple-throated Fruit-Crow) - A common bird along the edges of swamp forests in the vicinity of Almirante. Eighteen smears were examined and 2 were found positive for trypanosomes.

*Tityra semifasciata* (Masked Tityra) - One of 2 specimens seen was found infected with microfilariae.

#### PIPRIDAE (Manakins)

*Corapipo leucorhoa* (White-throated Manakin) - Four smears were examined, 1 of which exhibited *Haemoproteus* gametocytes and 1 a mixed *Haemoproteus*-microfilaria infection.

*Manacus vitellinus* (Gould's Manakin) - Very common in second growth and along the edge of swamp forests around Almirante. A total of 36 specimens

was examined, 1 of which had microfilariae and 1 a *Plasmodium vaughani*-like infection.

#### TYRANNIDAE (Tyrant Flycatchers)

*Colonia colonus* (Long-tailed Tyrant) - Commonly seen on dead trees along the edges of swamp forests in Almirante. Three specimens were examined during the survey. One was positive for *Haemoproteus* and 1 for microfilariae.

*Megarhynchus pitangua* (Boat-billed Flycatcher) - This is a large, conspicuous species commonly encountered along the edges of town in Almirante. Twenty smears out of 64 were found to have blood parasites. Twelve had *Haemoproteus* gametocytes, 7 microfilariae, 4 trypanosomes, 1 a *Plasmodium circumflexum*-like parasite and 2 a *P. relictum*-like infection.

*Nuttallornis borealis* (Olive-sided Flycatcher) - A migrant from the north which is occasionally encountered in Almirante during the fall. One specimen out of 4 examined had trypanosomes in the blood.

*Pipromorpha oleaginea* (Ochre-bellied Flycatcher) - Common along the edges of swamp forest around Almirante. Six smears of this species were examined and 2 were found to harbor blood parasites. One showed *Leucocytozoon* gametocytes and 1 microfilariae.

*Pitangus sulphuratus* (Kiskadee Flycatcher) - This is a large conspicuous species commonly seen around mangrove swamps. Out of 12 specimens, 2 were found positive. One had trypanosomes and the other microfilariae.

*Tyrannus villosus* (Paiety Tyrannulet) - A small species very common in lowland forests in the study area. Out of 41 smears seen, 6 had blood parasites. Five showed *Haemoproteus* and 1 a *Plasmodium* similar to *P. relictum*.

*Tyrannus melancholicus* (Tropical Kingbird) - Very common in peri-domestic habitats. One specimen out of 21 was found to harbor a mixed *Haemoproteus*-microfilariae infection.

*Unidentified Tyrannidae* - There were 97 smears examined from tyrant flycatchers not specifically determined. Of these, 8 showed blood parasites. Two had mixed *Haemoproteus*-trypanosome infections, 1 a *Plasmodium circumflexum*-like parasite and 5 microfilariae.

#### HIRUNDINIDAE (Swallows)

*Petrochelidon pyrrhonota* (Cliff Swallow) - A migrant from the north seen in early fall perching on wires and in upper canopy of swamp forests. Four smears of this species were seen and 2 were found infected with *Plasmodium polare*.

*Progne chalybea* (Gray-breasted Martin) - A common swallow around Almirante. Fifty-two specimens were examined and 3 were found with blood parasites. Of these, 2 had *Leucocytozoon* and 1 microfilariae.

## TROGLODYTIDAE (Wrens)

*Cyborbinus phoecephalus* (Song Wren) - In the study area this species is common along clearings in upland forests. Thirteen smears were examined and 1 exhibited microfilariae.

*Thryothorus nigricapillus* (Black-capped Wren) - Rare in the study area. Five specimens were examined and 1 was found infected with an unidentified *Plasmodium* parasite.

## MIMIDAE (Mockingbirds)

*Dumetella carolinensis* (Catbird) - A migrant from the north that stays in numbers as a winter visitant in the study area from mid-October to early May. A total of 29 specimens was collected and 1 was found to harbor microfilariae.

## TURDIDAE (Robins and Thrushes)

*Hylocichla mustelina* (Wood Thrush) - A migrant occurring as a winter visitant in Almirante from about October 8 through the month of April. A specimen banded in Charleston, S.C. on October 8, 1963 was recovered by Galindo and Méndez (2) in Almirante 18 days later. Eleven smears of this species were examined and 4 were found positive. Three of these had a species of *Leucocytozoon* and 2 had microfilariae.

*Hylocichla ustulata* (Swainson's Thrush) - A common migrant seen frequently in the study area from late September through November and again from late March through April. A total of 121 smears was seen, 18 of which had blood parasites. Of these, 7 had microfilariae, 6 *Leucocytozoon*, 1 a *Plasmodium circumflexum*-like parasite, 1 a *P. hexamerium*-like infection, 1 an undetermined species of *Plasmodium*, 2 trypanosomes and 1 *Haemoproteus*.

*Hylocichla minima* (Gray-cheeked Thrush) - An early migrant from the north. It is common in the Almirante area from the last week in September through the second week in November, but is very rarely seen in the spring. Of 4 specimens examined, 1 had a *Leucocytozoon* infection.

*Myadestes melanops* (Black-faced Solitaire) - This species is frequently encountered in the upland tropical rainforest covering the slopes to the west of Almirante. Three smears were prepared from specimens taken in the Changuena area and 1 was positive for *Haemoproteus*.

*Turdus obsoletus* (Cocoa Robin) - A highland species chiefly found in cloud forest habitats. A single specimen collected in the Changuena area was found to harbor *Haemoproteus*.

*Turdus grayi* (Clay-colored Robin) - One of the commonest birds in the vicinity of Almirante. Out of 52 specimens which came to hand, 3 were positive for blood parasites. Two of these had microfilariae, 1 trypanosomes and 2 *Haemoproteus*.

## VIREONIDAE (Vireos)

*Vireo flavifrons* (Yellow-throated Vireo) - A North American migrant. The single specimen examined had a mixed *Haemoproteus*-trypanosome infection.

*Vireo olivaceus* (Red-eyed Vireo) - An early migrant from North America appearing in the study area as early as the second week in August. Five smears were seen and 1 was positive for *Leucocytozoon*.

## COEREBIDAE (Honey creepers)

*Coereba flaveola* (Bananaquit) - A common bird in peridomestic habitats, nesting the year-around in our study area. Out of 17 specimens examined, 2 were found positive. One had a mixed *Plasmodium*-microfilariae infection and 1 harbored microfilariae alone.

## PARULIDAE (Wood Warblers)

*Dendroica petechia* (Yellow Warbler) - A migrant from the north. Nineteen smears of this species were seen and 4 were found positive. Two of these had trypanosomes, 1 *Haemoproteus* and 1 a *Plasmodium vaughani*-like parasite.

*Geothlypis semiflava* (Baird's Yellowthroat) - A rather common species seen chiefly along the margins of swampy forests. Five specimens came to hand, 1 of which was found positive for *Haemoproteus*.

*Seiurus noveboracensis* (Northern Waterthrush) - A common North American migrant seen in the study area throughout the fall and winter. Single infections of *Leucocytozoon*, trypanosomes and a *Plasmodium hexamerium*-like parasite were seen in 24 smears examined.

*Unidentified Parulidae* - Five blood smears were examined from warblers not identified to species and 1 was found positive for microfilariae.

## ICTERIDAE (Orioles and allies)

*Dolichonyx oryzivorus* (Bobolink) - A rare migrant from the north, chiefly seen around open fields in the fall. Five specimens were examined and 11 had a mixed *Plasmodium*-*Haemoproteus*-trypanosome infection. The *Plasmodium* parasite resembled *P. vaughani*.

*Gymnostinops montezuma* (Montezuma Oropendola) - Colonies of nests of this species are seen high up in the upper branches of trees at the edge of forests from March through June. Twelve specimens were collected and 2 were found with microfilariae.

*Cacicus microrhynchus* (Scarlet-rumped Cacique) - Rare in the Almirante area. Out of 3 smears examined 2 were found positive. Both specimens had microfilariae while 1 had additional infections of *Plasmodium* sp. and *Leucocytozoon*.

*Amblycercus holosericeus* (Prevost's Cacique) - Rather common in low-land rain forests. Four out of 14 specimens examined exhibited blood parasites. Three had *Plasmodium vaughani*-like infections and 1 *P. relictum*-like parasites.

*Icterus galbula* (Baltimore Oriole) - A North American migrant rather rare in the study area. It is chiefly seen early in the fall. Five smears were examined and 2 were positive for blood parasites. One had a mixed *Plasmodium-Haemoproteus* infection and the other microfilariae. The *Plasmodium* parasite resembled *P. circumflexum*.

*Icterus mesomelas* (Yellow-tailed Oriole) - A common bird around banana plantations and along edges of open marshes. Two *Plasmodium* infections were observed in 14 smears examined. One resembled *P. relictum* and the other *P. hexamerium*.

*Icterus spurius* (Orchard Oriole) - A North American migrant not commonly seen in the Almirante area. One of 2 specimens were found infected with a *Plasmodium nucleophilum*-like parasite.

#### THRAUPIDAE (Tanagers)

*Tanagra luteicapilla* (Yellow-crowned Euphonia) - Fairly common in second growth thickets. A single specimen out of 3 examined was found to harbor a mixed infection of *Haemoproteus* and a *Plasmodium relictum*-like parasite.

*Thraupis virens* (Blue-gray Tanager) - A common bird in peridomestic habitats. Seventy-seven smears were examined and 5 were found positive with the following blood parasites: microfilariae (4), trypanosomes (1), *Haemoproteus* (1).

*Ramphocelus passerinii* (Scarlet-rumped Tanager, Passerini's Tanager) - One of the commonest birds in peridomestic habitats and along the edges of open marshes. Out of 707 blood smears of this species examined 433, or 61.2%, were found positive for parasites. One hundred and ten specimens had *Plasmodium*, 386 *Haemoproteus*, 4 trypanosomes and 49 microfilariae. Of the plasmodia, the commonest was a species morphologically like *P. hexamerium* with 101 infections. Three additional species similar to *P. relictum*, *P. cathemerium* and *P. vaughani* were also observed in 7, 3 and 3 smears respectively.

*Pblogothraupis sanguinolenta* (Crimson-collared Tanager) - A rare species found together with the preceding one. Of 2 specimens examined, 1 had a mixed infection caused by a *Plasmodium vaughani*-like parasite and microfilariae.

*Piranga rubra* (Summer Tanager) - A common migrant from North America. Fifteen out of 23 smears had blood parasites. Of these, 12 exhibited *Haemoproteus* gametocytes, 4 microfilariae, 2 trypanosomes, and 1 a *Plasmodium circumflexum*-like infection.

*Piranga olivacea* (Scarlet Tanager) - A North American migrant much rarer than the preceding species. In Almirante it appears from late fall to early spring in its drab olive-green winter plumage. Ten specimens came to hand, 5 of which had blood parasites. Three were found with *Haemoproteus* and 2 with unidentified species of *Plasmodium*.

*Habia fuscicauda* (Dusky-tailed Ant-Tanager) - Fairly common in deeply shaded shrubs in swamp forests around Almirante. Four out of 6 smears examined had blood parasites. Three showed microfilariae and 1 had a trypanosome infection.

*Tachyphonus rufus* (White-shouldered Tanager) - A common species around fruit orchards. Sixteen specimens were examined and 3 were found positive. One showed a *Plasmodium vaughani*-like infection and 2 had microfilariae.

*Heterospingus rubrifrons* (Sulphur-rumped Tanager) - A rare species. In the study area it was found only in upland tropical rain forest. Two specimens taken in the Changuena area harbored mixed infections of *Haemoproteus* and trypanosomes.

*Mitrospingus cassinii* (Cassin's Tanager) - Rather common in well-drained rain forests in the study area. Six specimens were examined, 1 of which had trypanosomes and 1 microfilariae.

#### FRINGILLIDAE (Sparrows and allies)

*Sporophila aurita* (Variable Seedeater) - Very common in second growth thickets around Almirante. Out of 358 specimens examined, 52 showed parasites in the blood. *Haemoproteus* gametocytes were found in 46 of these, microfilariae in 6 and *Plasmodium* in 5. Three of the latter infections were much like *P. cathemerium* and 2 could not be studied beyond generic limits.

*Volatinia jacarina* (Blue-black Grassquit) - In Almirante, this species occurs together with *S. aurita* but in lesser numbers. A total of 38 smears were examined and 7 were found to harbor blood parasites. Five birds had *Haemoproteus* gametocytes, 1 a *Plasmodium cathemerium*-like parasite and there was 1 mixed *Haemoproteus-Plasmodium* infection.

*Oryzoborus funereus* (Lesser Rice Grosbeak) - Another inhabitant of grassy thickets in the Almirante area. Three *Haemoproteus* infections were observed in 48 specimens examined.

*Cyanocopsa cyanooides* (Blue-black Grosbeak) - Fairly common in low shrubs within swamp forests. One out of 17 specimens showed a mixed *Plasmodium relictum*-microfilariae infection.

*Pheucticus ludovicianus* (Rose-breasted Grosbeak) - A North American migrant seen chiefly in early fall. One out of 2 blood smears examined showed *Haemoproteus* parasites.

*Saltator atriceps* (Black-headed Saltator) - Common along the edges of swamp forests and in cacao groves in the Almirante area. A total of 123 specimens were examined, 28 of which were found with blood parasites. Of these, 18 had plasmodia and 11 microfilariae. Fifteen of the *Plasmodium* infections resembled *P. vaughani*, 2 appeared like *P. relictum* and 1 was a mixed *relictum-vaughani* infection.

*Saltator maximus* (Buff-throated Saltator) - Common in second growth scrub. Two out of 50 smears showed blood parasites. One had *Haemoproteus* gametocytes and the other a mixed *Haemoproteus-Plasmodium relictum* infection.

*Arremon aurantirostris* (Orange-billed Sparrow) - Common in upland

tropical rain forest also occurring, but in lesser numbers, in swamp forests. A single *Plasmodium vaughani*-like infection was found in 16 specimens examined.

*Arremonops conirostris* (Green-backed Sparrow) - Very Common in second-growth scrub around Almirante. A total of 60 smears was examined, 24 of which showed blood parasites. There were 22 specimens with *Plasmodium*, 5 with microfilariae and 1 with *Haemoproteus* parasites. Two species of *Plasmodium* were observed, one closely resembling *P. vaughani* with 21 infections and the other much like *P. cathemerium* with 8 positive smears.

*Unidentified passerine birds* - There were 3 smears of passerine birds without specific identification which showed blood parasites. Two had *Haemoproteus* infections and 1 showed microfilariae.

### SPECIES OF BIRDS NOT FOUND INFECTED WITH BLOOD PARASITES

The following species of birds were found free of blood parasites in the present survey. Numbers in parentheses refer to specimens examined. TINAMIDAE: *Crypturellus soui*, Pileated Tinamou (15). PODICIPEDIDAE: *Podiceps dominicus*, Least Grebe (3). PELECANIDAE: *Pelecanus occidentalis*, Brown Pelican (1). PHALACROCORACIDAE: *Phalacrocorax olivaceus*, Olivaceous Cormorant (2). ANHINGIDAE: *Anhinga anhinga*, Anhinga (1). ARDEIDAE: *Ardea herodias*, Great Blue Heron (1); *Hydranassa tricolor*, Tricolored Heron (1); *Agamia agami*, Agami Heron (1); *Florida caerulea*, Little Blue Heron (10); *Leucophoyx thula*, Snowy Egret (1); *Nyctanassa violacea*, Yellow-crowned Night-Heron (1); *Tigrisoma salmoni*, Salmon's Tiger-Bittern (1); *Bubulcus ibis*, Cattle Egret (3). ANATIDAE: *Anas discors*, Blue-winged Teal (4). CATHARTIDAE: *Sarcorhamphus papa*, King Vulture (1); *Coragyps atratus*, Black Vulture (4). ACCIPITRIDAE: *Harpagus bidentatus*, Double-toothed Kite (3); *Buteo magnirostris*, Large-billed Hawk (2); *Leucopternis semiplumbea*, Semiplumbeous Hawk (1); *Leucopternis princeps*, Barred Hawk (1); *Leptodon cayanensis*, Cayenne Kite (1); *Buteogallus anthracinus*, Lesser Black Hawk (1). FALCONIDAE: *Herpetotheres cachinnans*, Laughing Falcon (1); *Daptrius americanus*, Red-throated Caracara (1); *Falco albicularis*, Bat Falcon (1). CRACIDAE: *Crax rubra*, Central American Curassow (1). RALLIDAE: *Laterallus albicularis*, White-throated Rail (30); *Porzana carolina*, Sora Rail (1); *Porphyryula martinica*, Purple Gallinule (1). JACANIDAE: *Jacana spinosa*, Northern Jacana (3). SCOLOPACIDAE: *Capella gallinago*, Common Snipe (1). LARIDAE: *Thalasseus maximus*, Royal Tern (1). COLUMBIDAE: *Geotrygon veraguensis*, Olive backed Quail-Dove (1); *Geotrygon montana*, Ruddy Quail Dove (1). PSITTACIDAE: *Aratinga finschi*, Finsch's Parakeet (14); *Aratinga astec.* Aztec Parakeet (1); *Amazona autumnalis*, Redfronted Parrot (1); *Amazona farinosa*, Mealy Parrot (8); *Unidentified species* (2). CUCULIDAE: *Neomorphus geoffroyi*, Rufous-vented Ground Cuckoo (1). CAPRIMULGIDAE: *Caprimulgus rufus*, Rufous Nightjar (1); *Nyctidromus albicollis*, Pauraque (4). TROCHILIDAE: *Amazilia tzacatl*, Rieffer's Hummingbird (71); *Glaucis hirsuta*, Hairy Hermit (2); *Phaethornis superciliosus*, Long-tailed Hermit (5); *Eutoxeres aquila*, Com-



mon sicklebill (2), *Heliodoxa jacula*, Green-crowned Brilliant (1); *Unidentified species* (10). APODIDAE: *Chaetura pelagica*, Chimney Swift (5). TROGONIDAE: *Trogon rufus*, Graceful Trogon (1); *Trogon massena*, Massena Trogon (9). ALCEDINIDAE: *Chloroceryle americana*, Green Kingfisher (11); *Chloroceryle inda*, Green-and-rufous Kingfisher (2); *Megaceryle torquata*, Ringed Kingfisher (6). GALBULIDAE: *Galbula ruficauda*, Rufous-tailed Jacamar (1); *Jacamerops aurea*, Great Jacamar (1). BUCCONIDAE: *Monasa morphoeus*, White-fronted Nunbird (1); *Notharcus tectus*, Pied Puffbird (1). PICIDAE: *Celeus castaneus*, Chestnut-colored Woodpecker (8); *Piculus simplex*, Bugaba Woodpecker (1); *Unidentified species* (1). DENDROCOLAPTIDAE: *Campylorhynchus pusillus*, Brown-billed Sicklebill (2); *Dendrocincla fuliginosa*, Brown Dendrocincla (3); *Dendrocincla homochroa*, Ruddy Dendrocincla (2); *Xiphorhynchus guttatus*, Buff-throated Woodhewer (10); *Xiphorhynchus lachrymosus*, Black-striped Woodhewer (5); *Xiphorhynchus triangularis*, Spotted Woodhewer (1); *Glyphorhynchus spirurus*, Wedge-billed Woodhewer (1). FURNARIIDAE: *Premnoplex brunnescens*, Spotted Barbtail (2); *Sclerurus guatemalensis*, Scalythroated Leafscraper (2); *Xenops minutus*, Plain Xenops (2). FORMICARIDAE: *Cercomacra nigricans*, Black Tyrannine Antbird (1); *Thamnophilus punctatus*, Slaty Antshrike (1); *Dysithamnus puncticeps*, Spot-crowned Antvireo (3); *Gymnopithys leucaspis*, Bicolored Antbird (4); *Hylophylax naevioides*, Spotted Antbird (3); *Myrmeriza immaculata*, Immaculate Antbird (2); *Myrmotherula surinamensis*, Streaked Antwren (1); *Phaenostictus macleannani*, Ocellated Antthrush (1); *Pittasoma michleri*, Black-crowned Antpitta (1); *Taraba major*, Great Antshrike (2); *Unidentified species* (3). COTINGIDAE: *Lipaugus unirufus*, Rufus Piha (4); *Procnias tricarunculata*, Three-wattled Bellbird (4); *Rhytipterna holerythra*, Rufous Mourner (1). PIPRIDAE: *Pipra mentalis*, Yellow-thighed Manakin (6). TYRANNIDAE: *Contopus sordidulus*, Western Wood-Pewee (5); *Empidonax traillii*, Traill's Flycatcher (4); *Mionectes olivaceus*, Olive-striped Flycatcher (3); *Muscivora forficata*, Scissor-tailed Flycatcher (1); *Todirostrum cinereum*, Common Tody Flycatcher (1); *Myiobius sulphureipygius*, Sulphur-rumped Flycatcher (4); *Myiodynastes luteiventris*, Sulphur-bellied Flycatcher (1); *Onychorhynchus mexicanus*, Northern Royal Flycatcher (1); *Platyrhynchus coronatus*, Golden-crowned Spadebill (1); *Tyrannulus elatus*, Yellow-crowned Tyrannulet (1); *Legatus leucophaeus*, Striped Flycatcher (1). HIRUNDINIDAE: *Hirunda rustica*, Barn Swallow (29); *Unidentified Swallows* (3). CORVIDAE: *Psilorhinus morio*, Brown Jay (1). TROGLODYTIDAE: *Campylorhynchus zonatus*, Banded Wren (1); *Thryothorus atrogularis*, Black-throated Wren (13); *Thryothorus iboracicus*, Stripe-breasted Wren (6); *Thryothorus zeledoni*, Zeledon's Wren (5); *Thryothorus* spp. (6); *Henicorbina leucosticta*, White-breasted Wood Wren (1). TURDIDAE: *Catharus mexicanus*, Black-headed Nightingale Thrush (9); *Hyllocichla fuscescens*, Veery (2). SYLVIIDAE: *Microbates cinereiventris*, Halfcollared Gnatwren (1). COEREBIDAE: *Dacnis cayana*, Blue Dacnis (1); *Chlorophanes spiza*, Green Honeycreeper (1); *Cyanerpes lucidus*, Shining Honeycreeper (1). PARULIDAE: *Dendroica pennsylvanica*, Chesnut-sided Warbler (3); *Dendroica coronata*, Myrtle Warbler (1); *Icteria virens*, Yellow-breasted Chat (2); *Wilsonia canadensis*, Canada Warbler

(1); *Helmintheros vermivorus*, Worm-eating Warbler (1); *Oporornis formosus*, Kentucky Warbler (2); *Oporornis philadelphia*, Mourning Warbler (4); *Seiurus aurocapillus*, Ovenbird (1); *Seiurus motacilla*, Louisiana Water-thrush (2); *Phaeothlypis fulvicauda*, Buff-rumped Warbler (1); *Protonotaria citrea*, Protonotary Warbler (1); *Setophaga ruticilla*, Redstart (1); *Vermivora peregrina*, Tennessee Warbler (2); *Vermivora pinus*, Blue-winged Warbler (1); *Vermivora chrysoptera*, Golden-winged Warbler (1) ICTERIDAE: *Icterus prosthemelas*, Lesson's Oriole (12); *Zarhynchus wagleri*, Wagler's Oropendola (3). THRAUPIDAE: *Tanagra anneae*, Tawny-capped Euphonia (1); *Tanagra minuta*, White-vented Euphonia (1); *Tanagra gouldi*, Gould's Euphonia (12); *Tanagra lanirostris*, Thick-billed Euphonia (1); *Tangara florida*, Emerald Tanager (1); *Tangara inornata*, Plain-colored Tanager (2); *Tangara larvata*, Golden-masked Tanager (14); *Tangara icterocephala*, Silverthroated Tanager (1); *Thraupis palmarum*, Palm Tanager (5). FRINGILLIDAE: *Atlapetes brunneinucha*, Chestnut-capped Atlapetes (2); *Caryothraustes poliogaster*, Bishop Grosbeak (4); *Pitylus grossus*, Slate-colored Grosbeak (2); *Spiza americana*, Dickcissel (1); *Sporophila torqueola*, White-collared Seedeater (1); *Passerina cyanea*, Indigo Bunting (1). Unidentified passerine birds (22).

### ACKNOWLEDGEMENTS

The authors wish to express their appreciation to Mr. Eustorgio Méndez, Vertebrate Zoologist at Gorgas Memorial Laboratory, who identified many of the birds herein reported. Final confirmation of the identity of most of the species of birds collected is due to Dr. Alexander Wetmore, Smithsonian Institution. Dr. Eugene Eisenmann, American Museum of Natural History, examined a preliminary list of the avian species reported and suggested a number of nomenclatorial changes. He also made definitive identification of a number of skins of doubtful identity which he was able to examine on one of his trips to Panama.

### SUMMARY

A single-smear survey for blood parasites was conducted among birds of an area with a tropical rain forest climate in Panama. Birds were collected from a variety of habitats including swamp forests, open fresh water marshes, peridomestic and second growth association and upland tropical rain forests. Smears from 3,634 birds belonging to 249 species, 48 families and 19 orders were examined and 926, or 25.5%, were found to harbor blood parasites. There were 5 main groups of parasites observed, namely, *Plasmodium* with 233 positive smears, *Haemoproteus* with 589, microfilariae with 224, trypanosomes with 61 and *Leucocytozoon* with 18. Ten different types of *Plasmodium* were recognized, of these, three did not seem to agree morphologically with any of the described forms of avian plasmodia and were designated in this survey as "Butorides", "Casmerodius" and "Piaya" types. They were recorded from the Green Heron, the Common Egret and the Squirrel Cuckoo, respectively. The remaining seven

types resembled morphologically the following species: *P. relictum*, *P. cathemerium*, *P. hexamerium*, (= *oti*), *P. nucleophilum*, *P. vaughani*, *P. polare*, and *P. circumflexum*. Twelve distinct types of microfilariae were recognized from 134 smears collected early in the survey. Of these, 2 resembled closely *Splendidofilaria webri* Anderson and *Pseudaproctella inornata* Anderson. Infections of *Leucocytozoon* were mainly found in North American migrants. There were only 6 smears found positive with this genus of blood parasites from four species of local birds, namely, a heron, a swallow, a flycatcher and an oriole. A list of all avian species collected is presented, giving the scientific and common names of each species. Brief notes on the habits and blood parasites of the species found infected are also included.

## RESUMEN

El material objeto de este informe fue colectado en el área de Almirante, Provincia de Bocas del Toro, durante los años de 1960 a 1963. Muestras de sangre de las aves capturadas durante ese período, fueron sometidas a examen parasitológico con el objeto de determinar los tipos de hemoparásitos que afectan la avifauna de esta área tropical.

Las principales asociaciones ecológicas del área son las siguientes:

- 1) Pluviselvas pantanosas.
- 2) Ciénagas expuestas al sol.
- 3) Pluviselvas de altura.
- 4) Asociaciones peridomésticas y de crecimiento secundario.

Los sitios de colectas fueron seleccionados en su mayoría a nivel del mar, cerca del pueblo de Almirante, pero algunos ejemplares fueron obtenidos en la foresta entre los 2,500 a 3,000 pies de altura.

Un total de 3,634 aves fueron examinadas, pertenecientes a 249 especies, 48 familias y 19 órdenes. El examen de extensiones de sangre reveló que 926 animales, o sea un 25.5% del total examinado, se encontraban parasitadas por hematozoarios al momento de captura. Se encontraron 233 casos de infecciones por *Plasmodium*, 589 con *Haemoproteus*, 224 con microfilarias, 61 con *Trypanosoma*, y 18 con *Leucocytozoon*.

De acuerdo con sus características morfológicas se pudieron apreciar diez tipos distintos de *Plasmodium*; tres de los cuales presentaron características un tanto distintas a las de especies ya conocidas, por esta razón son reportados en el presente trabajo como tipo "Butorides" (en *Butorides virescens*), tipo "Casmerodius" (en *Casmerodius albus*) y tipo "Piaya" (en *Piaya cayana*). Los siete tipos restantes de *Plasmodium* presentaron características morfológicas compatibles con las siguientes especies: *P. relictum*, *P. cathemerium*, *P. hexamerium* (= *oti*), *P. nucleophilum*, *P. vaughani*, *P. polare*, y *P. circumflexum*.

Se distinguieron doce tipos distintos de microfilarias aún cuando sólo se pudo lograr la identificación específica en dos casos; *Splendidofilaria webri* An-

derson (ex *Hylocichla ustulata*) y la *Pseudaproctella inornata* Anderson (ex *Hylocichla mustellina*).

El género *Leucocytozoon* fue observado principalmente en aves migratorias. Solamente cuatro especies de aves no-migratorias fueron encontradas con infecciones por *Leucocytozoon*.

Se presenta una lista de todas las especies de aves colectadas, y se incluyen comentarios acerca de los hábitos y parásitos de las especies reportadas infectadas.

## REFERENCES

1. ADAMES, A. J.  
1962. *Microfilarias de aves panameñas colectadas en Almirante, provincia de Bocas del Toro*. Tesis de Graduación para la Licenciatura en Biología y Química, Universidad de Panamá. 50 pp.
2. GALINDO, P. AND E. MÉNDEZ  
1965. Banding of thrushes and catbirds at Almirante, Panama. Second year of observations. *Bird Banding* 36: 233-239.
3. GALINDO, P., S. SRIHONGSE, ENID DE RODANICHE, AND MARGARET GRAYSON  
1966. An ecological survey for arboviruses in Almirante, Panama. 1959 - 1962. *Am. J. Trop. Med. Hyg.*, 15: 385-400.
4. MANWELL, R.  
1949. *Plasmodium oti* and *P. hexamerium*. *J. Parasitol.* 35: 561-565.
5. RENJIFO, S., C. SANMARTIN AND J. DE ZULUETA  
1952. A survey of the blood parasites of vertebrates in Eastern Colombia. *Act. Trop.*, 9: 151-169.
6. TAKOS, M.  
1947. Blood parasites of some Panamanian birds. *J. Parasitol.*, 33: 229-230.