

BLOOD PARASITES OF THE COWBIRD, GRACKLE, REDWING AND STARLING IN NEW JERSEY

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Since Opie's work in 1898 nearly 75 surveys for blood parasites of wild birds have been completed in the United States. New Jersey, however, is represented by only a few small samplings (Beaudette & Hudson, 1936; Stauber & Stauber, 1942). A study was therefore initiated to carry out an enzoological investigation of a large number of birds for an examination of their blood parasites in an attempt to determine the species, their incidence and prevalence in the avian hosts.

There are over 250 species of birds known to occur in New Jersey. It was decided that a more detailed study of a natural group of birds be undertaken rather than a general survey including only a few birds of many species. The group commonly called the "blackbirds" was selected because a number of species are found in the same flocks, they occur in great numbers in New Jersey and are relatively easy to trap. Four species of the group were chosen for study. The Redwinged Blackbird (*Agelaius phoeniceus*), the Common Grackle (*Quiscalus quiscula*) and the Brown-headed Cowbird (*Molothrus ater*) belong to the Family Icteridae. The fourth species, the Starling (*Sturnus vulgaris*), is commonly associated with the blackbird group but actually is a member of the Family Sturnidae.

MATERIALS AND METHODS

The birds collected in this study were mainly caught in traps. Several types were utilized. Ten decoy traps (5.5 x 11.0 x 1.8 m) were erected in Salem and Pemberton Counties. One portable Australian crow trap was used effectively in wooded and urbanized areas frequented by grackles and starlings. Nylon mist nets (2 x 12 m) were used as an important supplement in capturing blackbirds in a variety of habitats, especially redwings in the marshlands.

Thin and thick blood smears were obtained by toe-clipping, wing and leg vein punctures and occasionally from a sample of blood taken from the jugular vein. Organ smears from 103 birds were prepared from the lung, liver, heart, kidney and spleen in an effort to discover tissue stages of the blood parasites. Giemsa's stain was employed in staining the organ smears and thin films for 10 minutes after they had been fixed in methyl alcohol for two minutes and air dried. Thick smears were not fixed but allowed to dry thoroughly and stained for 40-120 minutes with Giemsa's stain. Each smear was scanned under low power (100 x) for microfilariae and then examined under oil immersion (930 x) for 10 minutes or until at least 10,000 red blood cells had been counted. If no parasites were found the smear was considered negative.

Microfilarial counts were also made from a number of birds

using the unopette technique of Beam (1965) in his studies of microfilariae in dogs. A sample of 13 microliters of blood is mixed with 1.3 ml of 1 percent acetic acid and the sample is placed in a Scott counting slide and examined under a stereomicroscope (25 to 80 x). The results obtained make it possible to determine the number of microfilariae in a specified quantity of blood and thus indicate a relative degree of infection. Since microfilariae of birds are reportedly nocturnally periodic (Robinson, 1954) a number of birds kept in cages were sampled for microfilariae between 8 p.m. and 12:30 a.m.

Many birds were banded to observe if recaptures showed any change in blood parasite infections. Standard aluminum bands were obtained from the Bureau of Sport Fisheries and Wildlife for this purpose.

RESULTS

A total of 1,073 redwings, cowbirds, grackles and starlings were examined during the months of July, August and September, 1964 and May through October, 1965. Infections occurred in 317 (29.4 percent) of the four host species. Birds were captured in a number of areas in New Jersey but primarily in Burlington, Passaic, Salem and Middlesex counties. The number of birds of each species infected with blood parasites was tabulated under immatures (less than one year of age) and adults (Table 1). Where comparable numbers of birds were collected the data shows a greater percentage of immature redwings were infected than adults, while the reverse is true for grackles. The differences in the percentages of infections between species of adults is greater than the differences in the immatures. The percentages of infected birds for all age groups were 48.0 for grackles; 33.9 for redwings; 24.8 for cowbirds and 13.7 for the starlings.

Five species of *Plasmodium* were identified. Numbers of round and elongated types of *Plasmodium* which could not be identified to species, and numerous cases of unidentified trophozoites, were

TABLE 1. TOTALS AND PERCENTAGES OF IMMATURE AND ADULT COWBIRDS, GRACKLES AND STARLINGS EXAMINED AND FOUND POSITIVE FOR BLOOD PARASITES

Species of bird	Immature Birds			Adult Birds		
	Total Number of Birds Examined	Positive Birds No.	Percent	Total Number of Birds Examined	Positive Birds No.	Percent
Cowbird	26	4	15.4	191	50	26.1
Redwing	49	20	40.8	63	18	28.5
Grackle	209	84	44.2	166	96	57.8
Starling	288	41	14.2	40	4	10.0
TOTALS	572	149	26.0	460	168	36.5

seen. Only one case of *P. circumflexum* was discovered (cowbird). *P. relictum* was found in twice as many cases than either *P. cathemerium* or *P. hexamerium*. Two-thirds of the *P. relictum* infections were discovered in the grackles. *P. hexamerium* occurred in starlings in over 50 percent of the total cases in all four species of birds.

Haemoproteus was not found in any of the starlings examined. This parasite occurred almost exclusively in the grackle. In many instances the grackles infected with *Haemoproteus* also had parasitemias of *Leucocytozoon*. Cowbirds were infected more with *Leucocytozoon* (16 percent) than any other parasite.

Microfilariae were found in smears of nine birds. They were not found in any smear from the cowbird. Samples of blood taken from 33 caged birds between 8 p.m. and 12:30 a.m. revealed no incidence of microfilariae in these birds. All the birds were adults which had been captured in the field less than three days before the samples were taken.

A total of 52 multiple parasite infections were found. Individuals with two, three and four different parasites were seen a number of times. The majority of these were the *Haemoproteus* - *Leucocytozoon* combination which occurred primarily in the grackle. Starlings with multiple infections usually had two species of *Plasmodium* in their blood.

No infections of *Toxoplasma* or *Trypanosoma* were found in the birds examined. The results of the numbers of each type of blood parasite found in the four hosts are summarized in Table 2.

An examination of 103 contact organ smears produced nine infections. In the cases of *Plasmodium* the heart, spleen and lung

TABLE 2. TOTAL NUMBERS OF EACH TYPE OF BLOOD PARASITE FOUND IN GRACKLES, STARLINGS, COWBIRDS AND REDWINGS IN NEW JERSEY

	Species of Bird				Totals
	Grackle	Starling	Cowbird	Redwing	
Total No. Birds Infected	180	45	54	38	317
<i>Plasmodium relictum</i>	85	34	11	19	149
<i>cathemerium</i>	28	4	5	5	42
<i>elongatum</i>	10	8	0	2	20
<i>circumflexum</i>	8	2	0	2	12
<i>hexamerium</i>	0	0	1	0	1
Elongate type	8	11	1	2	22
Round type	12	3	3	2	20
Unidentified Trophozoites	19	6	1	6	32
<i>Haemoproteus</i>	19	8	8	8	43
<i>Leucocytozoon</i>	72	0	2	4	78
Microfilariae	56	5	35	9	105
Multiple Infections	5	2	0	2	9
	34	12	3	3	52

TABLE 3. LOCATIONS AND DATES OF BANDED AND RECAPTURED BIRDS WITH THE PARASITES FOUND UPON EXAMINATION WHEN BANDED AND RECAPTURED AND THE NUMBER OF DAYS BETWEEN EXAMINATIONS

Species of Bird	Location and Date First Banded	Parasites Found	Location and Dates of Recaptures	Parasites Found	Days Elapsed
Grackle	Salem 6-10-65	<i>Haemoproteus</i>	Salem 7-20-65	<i>Plasmodium</i>	40
Grackle	Pemberton 6-23-65	<i>Plasmodium</i>	Pemberton 7-1-65	<i>Plasmodium</i>	8
Grackle	Salem 6-11-65	<i>Haemoproteus</i>	Salem 8-4-65	Neg	54
Grackle	Salem 6-11-65	Neg	Salem 8-4-65	<i>Leucocytozoon</i>	54
Grackle	Salem 6-11-65	Neg	Salem 8-4-65	<i>Leucocytozoon</i>	54
Starling	Little Falls 6-12-65	Neg	Little Falls 9-5-65	Neg	85
Starling	Salem 6-10-65	Neg	Salem 6-29-65	Neg	19
			Salem 7-20-65	Neg	+21 = 40
Starling	Salem 6-10-65	Neg	Salem 6-30-65	Neg	20
Starling	Salem 7-8-65	Neg	Salem 7-14-65	Neg	6
Starling	Salem 7-20-65	Neg	Salem 7-21-65	Neg	1
			Salem 8-2-65	Neg	+13 = 14
Starling	Salem 7-20-65	Neg	Salem 7-23-65	Neg	3
Cowbird	Salem 7-20-65	Neg	Salem 7-22-65	<i>Leucocytozoon</i> & <i>Plasmodium</i>	2

were found to be heavily parasitized. Gametocytes of *Leucocytozoon* were detected in the heart, kidney (in large numbers), lung and spleen. *Haemoproteus* was seen in the lung and heart tissue of two birds.

As a result of banding 441 birds, 12 recaptures were made, two of these twice. Changes in parasitism are given in Table 3. All but one grackle demonstrated a change using the methods of examination in this study. Three grackles banded in mid-June were recaptured together on August 8th (54 days later). One of these birds showed an infection of *Haemoproteus* in June but no gametocytes were seen in the blood on the second examination. The second and third grackles presented parasitemias of *Leucocytozoon* on the second examination. The six starlings were negative at banding and recapture even though two of these birds were free over 40 days. A single cowbird recaptured after two days had gametocytes of *Leucocytozoon* and trophozoites of an unidentified species of *Plasmodium* circulating in its blood which were absent previously.

DISCUSSION

One of the first points usually considered in this type of study are the infection rates of the birds sampled and whether they are indicative of the total population. Usually when a large enough sample has been taken from a number of areas over a period of time a fair indication of both infection rates and incidence of parasites can be obtained from the data. The techniques and timing of sample taking along with uncontrollable factors such as vector activity in relation to time of year and bird habitat, immunity of hosts, parasite periodicity and others must be considered. Infection rates for the cowbird, grackle, redwing and starling in New Jersey are undoubtedly greater than stated in the results, due to a combination of the above factors. The areas selected for trapping these birds ranged from ridge and valley terrain (Passaic County), and pine barrens (Burlington County), to coastal plain (Salem County). The habitats of each host bird are somewhat different in each area and so also are the vectors capable of being potential transmitters of the parasites. Many of the blackbirds found in New Jersey in late fall and early spring are migrants. Infections in these birds may be acquired in summer or winter roosting areas in other states or in New Jersey as they pass through on the way to these areas. Transmission does occur in this state as was shown by Stauber & Stauber (1942) who found fledgling robins infected with species of *Plasmodium*. Over 25 percent of the immature birds in this study were infected. A great many of them were juveniles and undoubtedly received their infections from vectors which had fed on their parents or other adult birds.

Over 50 instances of birds with multiple infections were recorded. At present, mosquitoes are the only known vector of *Plasmodium*. *Culicoides* have been shown to be efficient vectors of *Haemoproteus* (Fallis & Bennett, 1961) as have the hippoboscid flies. Ornithophilic

simuliids have been shown as vectors of microfilariae (Anderson, 1956) and *Leucocytozoon* (Fallis & Bennet, 1961). Four grackles and one redwing were found infected with microfilariae, *Plasmodium*, *Leucocytozoon* and *Haemoproteus*. It is apparent that these birds had come into contact with more than one or two types of infective vectors. Grackles had binary, tertiary or quarternary infections in 19 percent of the cases.

Regarding the prevalence of the various parasites in each bird host, the factors discussed involving infection rates are again pertinent. *Plasmodium* was the predominant parasite found in this study. *Plasmodium cathemerium*, *P. elongatum*, *P. circumflexum* and *P. hexamerium* are added to those species already recorded for New Jersey (*P. relictum* var. *matulinum* and *P. vaughani*) by Stauber & Stauber (1942). The most common form was *P. relictum*, found in a large percentage of the cases in the grackle. In fact the grackle had more total numbers of infections than the three other bird species combined. Elongated and round types of *Plasmodium* which could not be identified as to species represented 20 and 32 cases respectively. Parasites occurring in these birds which could not be definitely defined as any of the known parasites encountered in avian blood cells (43 cases) were listed in Table 2 as unidentified trophozoites.

Leucocytozoon and *Haemoproteus* are difficult to classify from blood smears alone and these parasites were not distinguished as to species. *Leucocytozoon* was encountered second in numbers of infections, primarily in the grackle (56 cases) and cowbird (35 cases). Each parasitemia consisted of the round type of parasite found only in the lymphocytes. Clark (1965) working with *L. berestneffi* in the yellow-billed magpie found the lymphocytes were the only blood cells infected by this parasite. From the tissue smears *Leucocytozoon* was abundant in the kidney as found by Manwell (1951) in his work with purple grackles. *Haemoproteus* was not found in over 320 starlings examined. A possible reason for this is that the majority of the starlings were immatures and juveniles. If the period of sporozony in the vector takes one to two weeks and the prepatent period lasts up to five weeks it is evident that a number of infections might have been missed. More likely, however, since the parasite was found in the other bird species it seems that some other reason (such as nesting in tree holes and eaves of houses, which possibly excludes potential vectors from the transmitting parasites), is the limiting factor in this bird.

The infection rates for filarial worms cannot be considered representative for these birds for a number of reasons. As Robinson (1961) has stated, these parasites are usually nocturnally periodic and blood smears collected during the day would show only stray microfilariae. Making lung smears increases the chances of detecting filarial infections many fold, however, since many of the birds in this study were used in mark and release studies, only 100 birds were sacrificed for organ smears which included the lung. Examination of these 100 birds revealed no filarial infections.

Although blood parasites were diagnosed in 29.5 percent of the blackbirds it cannot be known for certain whether the adult birds were infected in New Jersey or not. Results from the limited banding and recovery of birds definitely indicated that some adult birds became infected here. Little research has been done in this area and there is need for the study of the wild bird and its parasites under field conditions. Methods of monitoring birds are difficult and results are usually meager in relation to the amount of effort expended. It is evident, nevertheless, that valuable information may be acquired which is often impossible to obtain in laboratory studies.

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