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Prevalence of *Haemoproteus columbae* in domestic pigeons (*Columba livia domestica*) reared in a coastal enclave of Southern India

Deva Ramu[a]* | Bhushan Krishnamurthy[a] | Devadharshini Jayakumar[a] | Siddhartha Sankar Das[a] | Mathivathani Cattavarayane[a] | Angeline Felicia Bora Christopher[a]

[a]Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry, 605009, India.

*Corresponding author: devaramu98@gmail.com

Abstract *Haemoproteus columbae* is a species of malarian parasite affecting pigeons coming under the family Plasmodiidae. A study was conducted to know the prevalence of *Haemoproteus columbae* in domestic pigeons of the coastal enclave of Puducherry, India, using thin blood smears stained with Giemsa and Leishman stain, which was confirmed by the presence of gametocytes in the RBCs. A total of 50 blood samples were collected and examined during the study, out of which 46 (92%) samples were found to be positive for *Haemoproteus columbae* in the adolescent and adult age group of birds, and the vector *Pseudolynchia canariensis* were also collected from the birds during the study period.

Keywords: blood smear, erythrocytes, gametocyte, *Pseudolynchia canariensis*, Puducherry

1. Introduction

Domestic pigeons belonging to the order Columbiformes are ubiquitous birds and can be found virtually in every town and city around the globe (Tietz et al 2007). Pigeon fancying is very popular among young people of Puducherry, India, who rear these birds as pets, race birds, and for meat purposes. *Haemoproteus columbae* is a common haemoprotozoa found in the erythrocytes of domestic pigeons, ducks, and turkeys. The infection is transmitted by louse flies (Hippoboscids) and midges (*Culicoides* sp.) (Taylor et al 2016).

The pathogenicity of *H.columbae* is generally low, and adult birds show no evidence of disease (Soulsby 1982). Although the symptoms of infection with haemoprotozoa usually are mild in birds, such parasites can affect avian body condition (Valkiūnas et al 2006), reproductive success (Tomás et al 2007), community structure (Ricklefs et al 2005) and possibly lead to host extinction (Atkinson et al 2000; Zhang et al 2014). Therefore, gathering epidemiological data on such parasites in a particular region is very important. As there are limited studies on Haemoproteus columbae infections in pigeons from India (Borkataki et al 2015), the primary aim of this study was to detect the prevalence of *Haemoproteus columbae* in Puducherry.

2. Materials and Methods

2.1. Study area

This study was carried out in Puducherry (11°55'N and 79°49'E) district between May and June 2022. Puducherry is classified as a tropical wet and dry climate region with an average elevation of 3 meters from sea level. The maximum temperature of the region ranges between 36 °C (97 °F) and 41 °C (106 °F), whereas the minimum temperature of the region ranges between 28 °C (82 °F) and 32 °C (90 °F). The samples were collected from domestic pigeons belonging to different communes of the Puducherry district, including Kalapet, Lawspet, Nellithope, Marie Oulgaret, Villianur, Bahour, Nettapakkam, and Thirukkanur (Figure 1).

2.2. Sample collection and processing

2.2.1. Sample collection

The samples were collected from domestic pigeons reared as pets and for racing purposes. On average, 20-50 birds were reared by an individual, and the sampled birds were grouped into two groups based on their age as adolescents and adults. The samples were of varying numbers in different communes (Figure 2), which is attributed to the non-uniform

distribution of pigeon fanciers in different communes. A total of 50 pigeons were physically restrained, and venipuncture of the medial metatarsal vein was done. A drop of blood was collected, and a thin smear was made on the clean glass slide. Additionally, the vector *Pseudolynchia canariensis* were also collected from the pigeons.

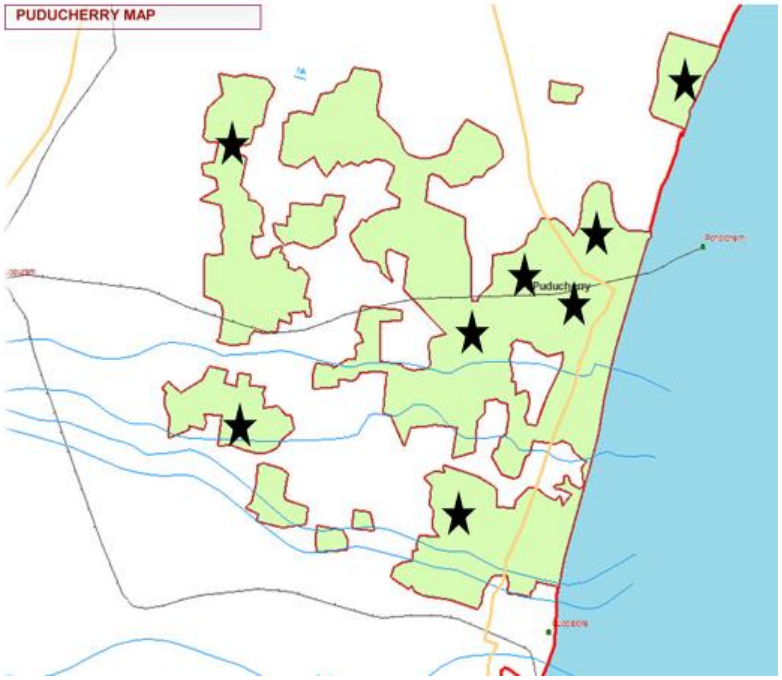

Figure 1 Map of coastal enclave showing sampling areas (★).

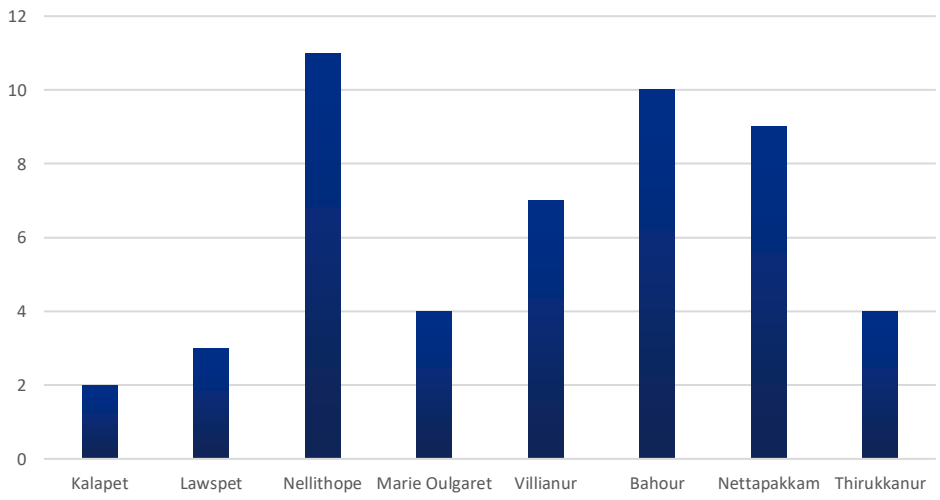

Figure 2 Samples collected from different communes of the Puducherry district.

2.2.2. Processing

The samples were stained and processed using two different staining methods:

Giemsa staining: The air-dried smears were fixed by covering the smear using absolute methanol for 5 minutes. Once dried, the smear was stained with a freshly prepared working solution of 10% Giemsa stain (1:10 dilution) for 40 minutes and washed under distilled water. The smears were then examined under a microscope for the presence of the parasite.

Leishman staining: The air-dried smears were covered with a sufficient quantity of Leishman stain for 1 minute. Then the stain was double diluted using distilled water, allowed to act for 10-15 minutes and washed under distilled water. The stained smears were then examined under the microscope for the presence of the parasite.

2.2.3. Interpretation

The stained blood smears were carefully examined for the presence of *H. columbae* in the RBCs under 1000× magnification (oil immersion). The infected erythrocytes were identified by the presence of gametocytes which may range from tiny forms to elongate crescent-shaped gamonts that encircle the nucleus in the form of a halter. The nucleus may be displaced but not to the edge of the cell. Macrogamonts are stained dark blue with a compact nucleus staining dark purple-red, and the pigments are scattered throughout the cytoplasm. Microgametocytes stain pale blue to pinkish, the nucleus is pale pink and diffuse, and the pigment granules are collected into a spherical mass (Soulsby 1982).

3. Results

From the study of 50 birds, 46 (92%) birds were positive for *Haemoproteus columbae* (Table 1; Figure 3 and 4). The smears were considered positive when one or more erythrocytes were infected with gametocytes, and slides were declared negative after examining a minimum of 1000 non-infected erythrocytes.

Table 1 Prevalence of *H. columbae* in different communes of the Puducherry district.

Location	No. of samples	Positive (%)
Kalapet	2	100
Lawspet	3	100
Nellithope	11	100
Marie Oulgaret	4	0
Villianur	7	100
Bahour	10	100
Nettapakkam	9	100
Thirukkanur	4	100
Total	50	92

Out of 50 blood smears, 43 belonged to the adolescent age group, and seven belonged to the adult age group. Upon microscopic examination, it was found that 41 out of 43 samples and five out of seven samples were positive for *H. columbae.* The prevalence of *H. columbae* in adolescent and adult age groups was found to be 95.34% and 71.42%, respectively (Table 2).

Table 2 Prevalence of *H. columbae* among different age groups.

Age group	Number of Samples	Number of Positive samples	Prevalence (%)
Adolescent (1-6 months)	43	41	95.34
Adult (>6 months)	7	5	71.42

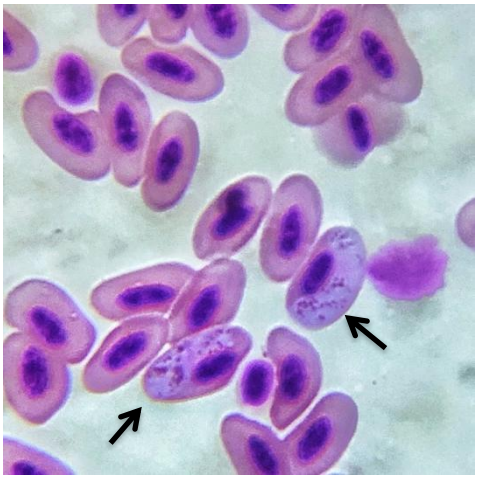

Figure 3 Gametocytes of *H. columbae* in erythrocytes (Giemsa stain).

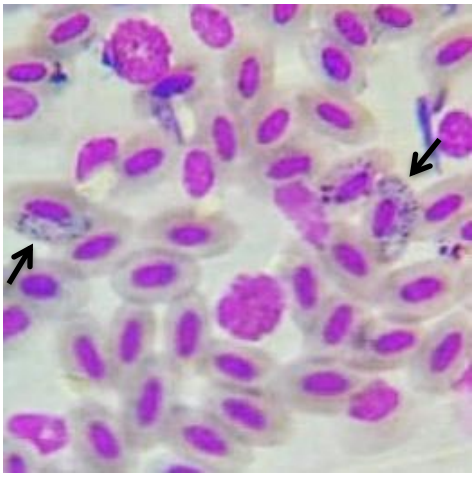

Figure 4 Gametocytes of *H.columbae* in erythrocytes (Leishman stain).

The vector *Pseudolynchia canariensis* was also isolated. The parasite is widely distributed in warm countries and lives on domestic pigeons and a few wild birds. The adult fly is dark brown, usually 6 mm long. It has a pair of transparent, tapering wings with the venation reduced and concentrated along the anterior border (Figure 5). The claws are strong and spurred (Soulsby 1982).

Figure 5 Dorsal view of the vector *Pseudolynchia canariensis.*

4. Discussion

The analysis of blood smears showed that 92% of the samples were positive for *H. columbae*. This indicates a high prevalence of *H. columbae* in the area of study. The remaining 8% of the samples did not show any parasitic infection in the smear analysis, and all belonged to the Marie Oulgaret commune. The findings in the study indicate higher prevalence and susceptibility to *H. columbae* infection in adolescent birds compared to the other age groups. Higher prevalence in younger birds may be caused by their higher exposure to vectors as nestlings and/or lack of immunity (Merino and Potti 1995; Sol et al 2003). Many studies have reported a significant negative or positive correlation between haemosporidian infections and different age and sex groups (Adinehbeigi et al 2018). Numerous endogenous and exogenous factors may have a cumulative impact on the infection status of both sexes of pigeons to these parasites, namely the host's hormones, humoral compounds, age, nutritional conditions, behaviours and habits, the season of the year (Adinehbeigi et al 2018). The prevalence of *H. columbae* varies globally from 14 to 100%. It is reported to be 57% in Turkey (Gicik and Arsalan 2001), Mumbai (Shinde et al 2008), 37 % in domestic pigeons of Morogoro municipality of Tanzania (Msoffe et al 2010), 24% in southwest Iran (Samani et al 2013), 58.33 % in, and 29.4% in Italy (Scaglione et al 2015), 76% in Libya (Alkharigy et al 2018).

In tropical India, a year-round abundance of parasitaemia in feral pigeons has been reported (Mandal, 1990). A similar prevalence study in the sub-tropical region of Jammu shows that 74.28% of the samples were positive for *H. columbae* (Borkataki et al 2015). Vector abundance was claimed to be the major factor influencing the spatial variation in the prevalence of *H. columbae* in pigeons (Borkataki et al 2015). The host-parasite relationship was suggested to differ in tropical from non-tropical areas (Møller, 1998), and tropical zones have a higher prevalence of parasite relapse infections, as well as increased vector abundance and decreased host immunocompetence (Durrant et al 2006). The high prevalence of parasitemia from the current study may be related to the higher bird density and tropical climate, which might have contributed to the increased fly population.

5. Conclusions

There is a high prevalence of *H. columbae* among domestic pigeons in the Puducherry district. This study is the first of its kind conducted in the coastal region of Southern India. This study also gives a better perspective in understanding the prevalence of H. columbae in domestic pigeons of the coastal enclave of the Puducherry district.

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Ethical Considerations

It is not necessary because it was only a comparison study of the lofts.

Conflict of Interest

There was no conflict of interest.

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References

Adinehbeigi K, Ebrahimi M, Soltani Eini M, Samie A (2018) Prevalence of *Haemoproteus columbae* (Apicomplexa: Haemoproteidae) and *Trichomonas gallinae* (Metamonada: Trichomonadidae) infections among pigeons (*Columba livia*) in West Azerbaijan Province, Iran. Archives of Razi Institute 73:147-152.

Alkharigy, Ferial A., Adnan S. El Naas, and Abdulhakim A. EL Maghrbi. "Survey of parasites in domestic pigeons (*Columba livia*) in Tripoli, Libya. Open veterinary journal 8:360-366.

Atkinson, Carter T, Robert J Dusek, Karen L Woods, William M Iko (2000) Pathogenicity of avian malaria in experimentally-infected Hawaii Amakihi. Journal of Wildlife Diseases 36:197-201.

Borkataki S, Katoch R, Goswami P, Godara R, Khajuria JK, Yadav A, Kour R, Mir I (2015) Incidence of *Haemoproteus columbae* in pigeons of Jammu district. Journal of Parasitic Diseases 39:426-428.

Durrant KL, Beadell JS, Ishtiaq F, Graves GR, Olson SL, Gering E, Peirce MA, Milensky CM, Schmidt BK, Gebhard C, Fleischer RC (2006) Avian hematozoa in South America: a comparison of temperate and tropical zones. Ornithological Monographs 98-111.

GicikY, Arslan MÖ (2001) Blood parasites of wild pigeons in Ankara District. Turkish Journal of Veterinary & Animal Sciences 25:169-172.

Mandal FB (1990) Seasonal incidence of blood-inhabiting *Haemoproteus columba*e Kruse (Sporozoa: Haemoproteidae) in pigeons. Indian Journal of Animal Health 29:29-35.

Merino S, Potti J (1995) High prevalence of hematozoa in nestlings of a passerine species, zthe pied flycatcher (*Ficedula hypoleuca*). Auk 112:1041–1043

Møller AP (1998) Evidence of larger impact of parasites on hosts in the tropics: investment in immune function within and outside the tropics. Oikos 265-270.

Msoffe PL, Muhairwa AP, Chiwang GH, Kassuku A (2010) A study of ecto-and endo-parasites of domestic pigeons in Morogoro Municipality, Tanzania.

Ricklefs RE, Swanson BL, Fallon SM, Martínez-Abraín A, Scheuerlein A, Gray J, Latta SC (2005) Community relationships of avian malaria parasites in southern Missouri. Ecological Monographs 75:543-559.

Samani AD, Kheirabadi KP, Samani AD (2013) Prevalence and rate of parasitemia of *Haemoproteus columbae* in *Columba livia domestica* in southwest of Iran. Iranian journal of parasitology 8:641.

Scaglione FE, Pregel P, Cannizzo FT, Pérez-Rodríguez AD, Ferroglio E, Bollo E (2015) Prevalence of new and known species of haemoparasites in feral pigeons in northwest Italy. Malaria Journal 14:1-5.

Shinde NG, Gatne ML, Singh A (2008) Prevalence of parasites in pigeons (*Columba livia domestica*) of Mumbai. Journal of Veterinary Parasitology 22:65-66.

Sol D, Jovani R, Torres J (2003) Parasite mediated mortality and host immune response explain age-related differences in blood parasitism in birds. Oecologia 135:542–547.

Soulsby EJL (1982) Helminths, Arthropods and Protozoa of Domesticated Animals. 7th edn, Balliere Tindall and Cassel, London, pp. 440, 700, 702.

Taylor MA, Coop RL, Wall RL (2016) Veterinary Parasitology, 4th edn, Wiley Blackwell, Oxford, pp. 148-149.

Marques T, Curados SM, Silva RJ, Baldo CM (2007) Parasites of pigeons (*Columba livia*) in urban areas of lages, Southern Brazil. Parasitología latinoamericana 62:183-187.

Tomás G, Merino S, Moreno J, Morales J, Martínez-De La Puente J (2007) Impact of blood parasites on immunoglobulin level and parental effort: a medication field experiment on a wild passerine. Functional Ecology:125-133.

Valkiūnas G, Tadas Ž, Anatoly PS, Tatjana AI (2006) Effect of Haemoproteus belopolskyi (Haemosporida: Haemoproteidae) on body mass of the blackca p Sylvia atricapilla. Journal of Parasitology 92:1123-1125.

Zhang Y, Yuchun W, Qiang Z, Dongdong S, Fasheng Z (2014) Prevalence patterns of avian Plasmodium and Haemoproteus parasites and the influence of host relative abundance in southern China. PloS one 9:e99501.