



The prevalence of *Haemoproteus* spp. in different avian groups from Southern Vietnam



Andrey Bushuev^{1,2,3}, Oleg Tolstenkov^{2,3,4}, Irina Demina⁵, Elena Platonova⁵, Olga Sokolova¹, Vũ Mạnh², Anvar Kerimov^{1,2,3}

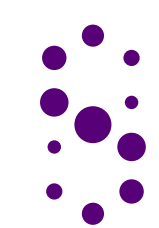
¹Department of Vertebrate Zoology, Faculty of Biology, Lomonosov Moscow State University, Moscow, Russia. E-mail: Bushuev@mail.bio.msu.ru

²Southern Branch of Joint Vietnam-Russia Tropical Science and Technology Research Center, Ho Chi Minh City, Vietnam

³A.N. Severtsov Institute of Ecology and Evolution of the Russian Academy of Sciences, Moscow, Russia

⁴Michael Sars Center, University of Bergen, Bergen, Norway

⁵Rybachy Biological Station, Zoological Institute, Russian Academy of Sciences, Kaliningrad, Russia



**Michael Sars
Centre**



INTRODUCTION

The prevalence of blood parasites in tropical birds of the Old World has been significantly less studied compared to birds in other regions. In this study, we assessed the relationship between the parasitemia levels of *Haemoproteus* spp. and various ecological, physiological, and taxonomic factors in free-living birds of southern Vietnam. Specifically, we compared the parasite load between long-distance migrants wintering in the tropics and sedentary tropical species. Previous research has shown that tropical birds possess more robust immune systems than those in temperate and high-latitude regions. Thus, we hypothesized that migrants would exhibit higher parasite loads compared to tropical residents.

MATERIALS

- **Study site:** Cát Tiên National Park (11°25'N, 107°25'E).
- **Study period:** Dry season (March to May) over six years.
- **Sample size:** 744 blood smears from 108 species (92 residents and 16 migrants; 67 passerine and 41 non-passerine species) representing 41 families across 13 orders.



METHODS

- **Bird capture:** Birds were caught using Ecotone mist nets.
- **Blood sampling and smear preparation:** Blood for smears was collected from the ulnar vein. The smears were air-dried, stained using May-Grünwald protocol followed by azure-eosin, and used to assess blood-cell and *Haemoproteus* spp. counts. Microscopy was conducted under 10x100 magnification with oil immersion (Fig. 1). The number of heterophils and lymphocytes was counted to calculate the H/L ratio based on a sample of 100 leukocytes. *Haemoproteus* spp. parasitemia and white blood cell count (WBC) were estimated by counting *Haemoproteus* spp. and leukocytes per 10,000 erythrocytes.
- **Ectoparasite assessment:** Birds were inspected for ectoparasites (Ischnocera and Amblycera chewing lice (Insecta: Phthiraptera), louse flies (Diptera, Hippoboscidae), and feather mites (Arachnida: Acariformes)) through visual inspection and a fumigation chamber with ethyl acetate.
- **Basal metabolic rate (BMR):** BMR was measured overnight using flow-through respirometry with an O₂/CO₂ FoxBox respirometer (Sable Systems).
- **Statistical analysis:** Binary logistic regression, negative binomial GLM, and zero-inflated negative binomial GLM were conducted using R software.

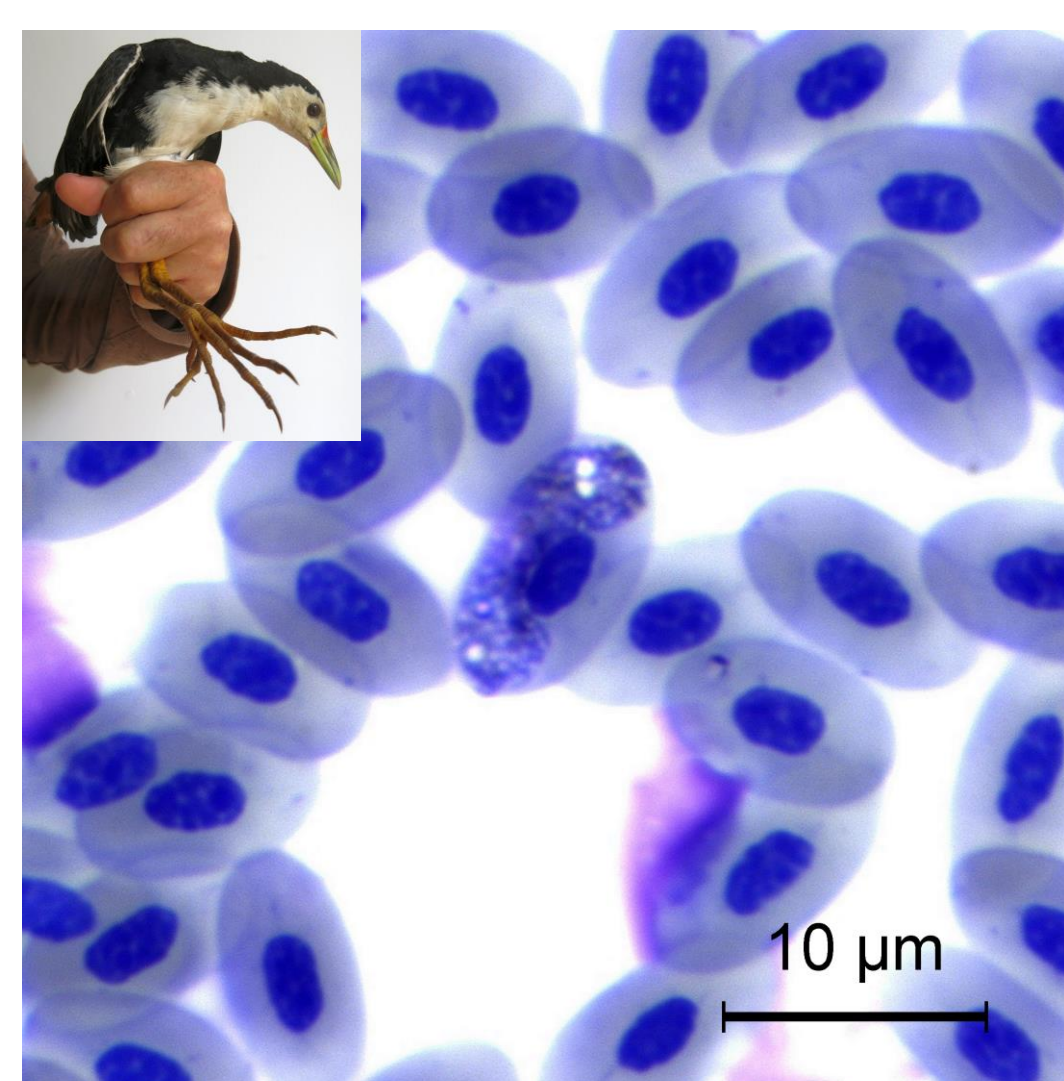


Fig. 1. A mature gametocyte of *Haemoproteus* spp. in the blood of a white-breasted waterhen (*Amaurornis phoenicurus*).

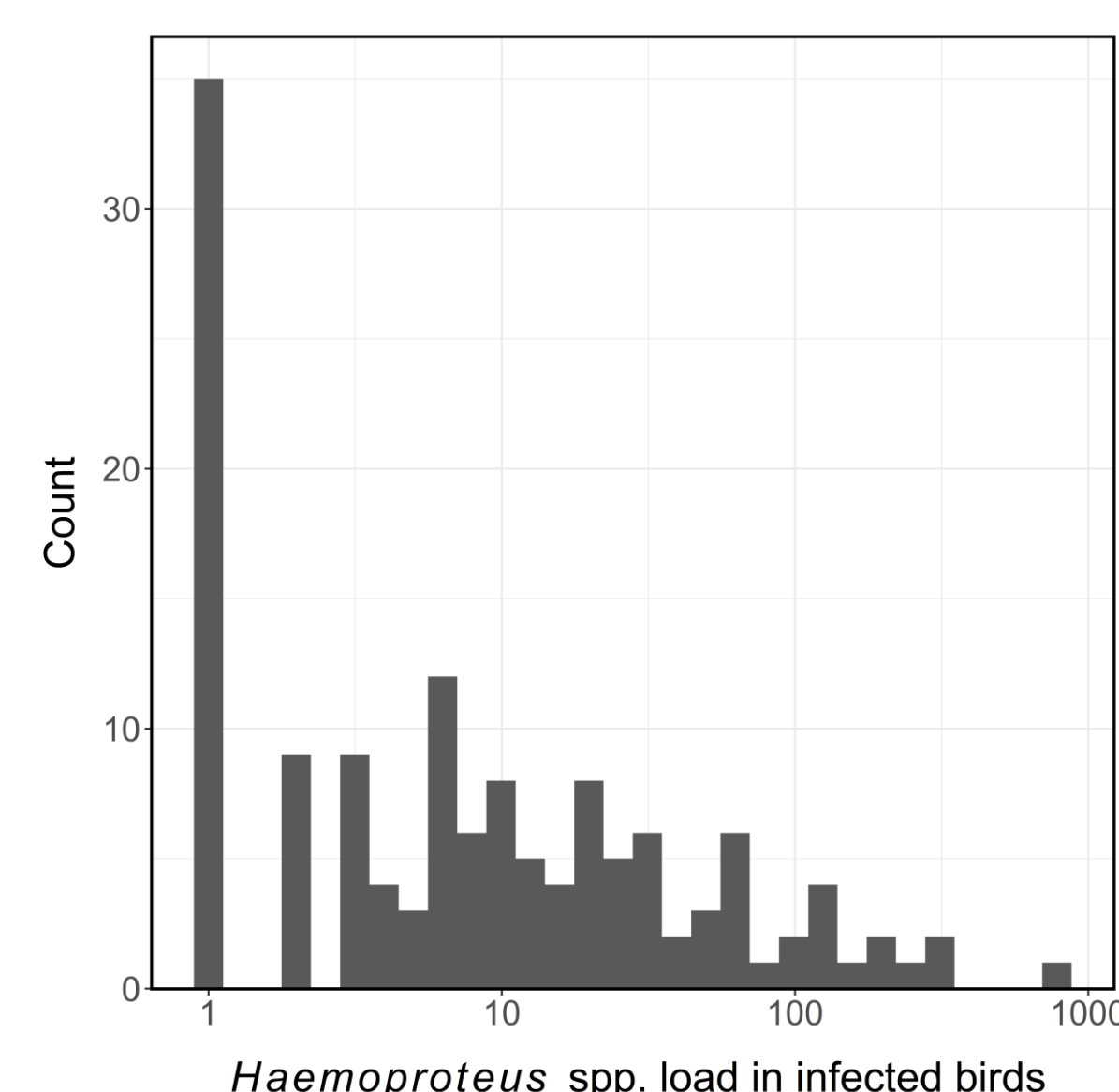


Fig. 2. *Haemoproteus* spp. load in infected tropical birds.

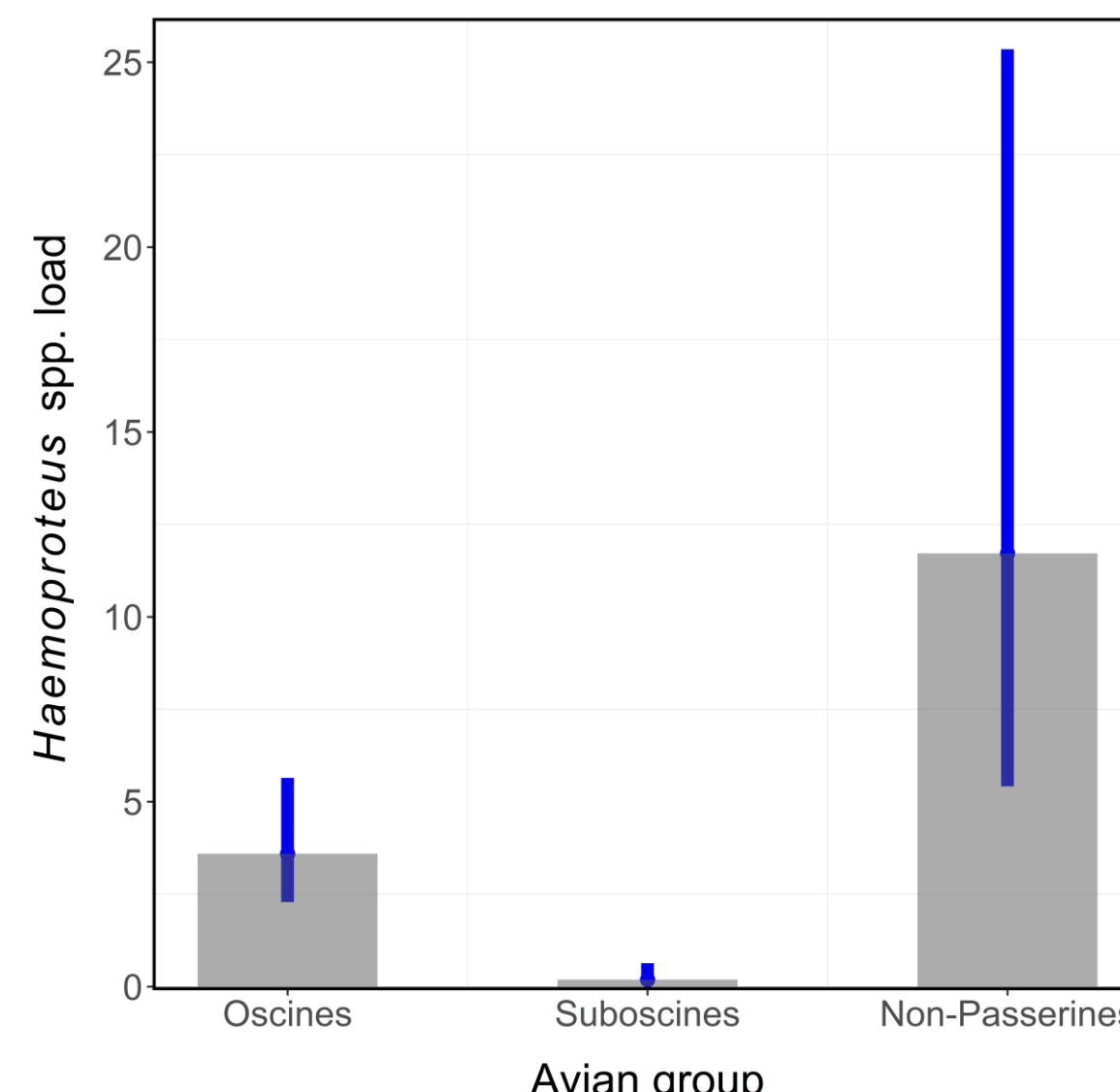


Fig. 3. Model-predicted *Haemoproteus* spp. load in different groups of sedentary tropical birds.

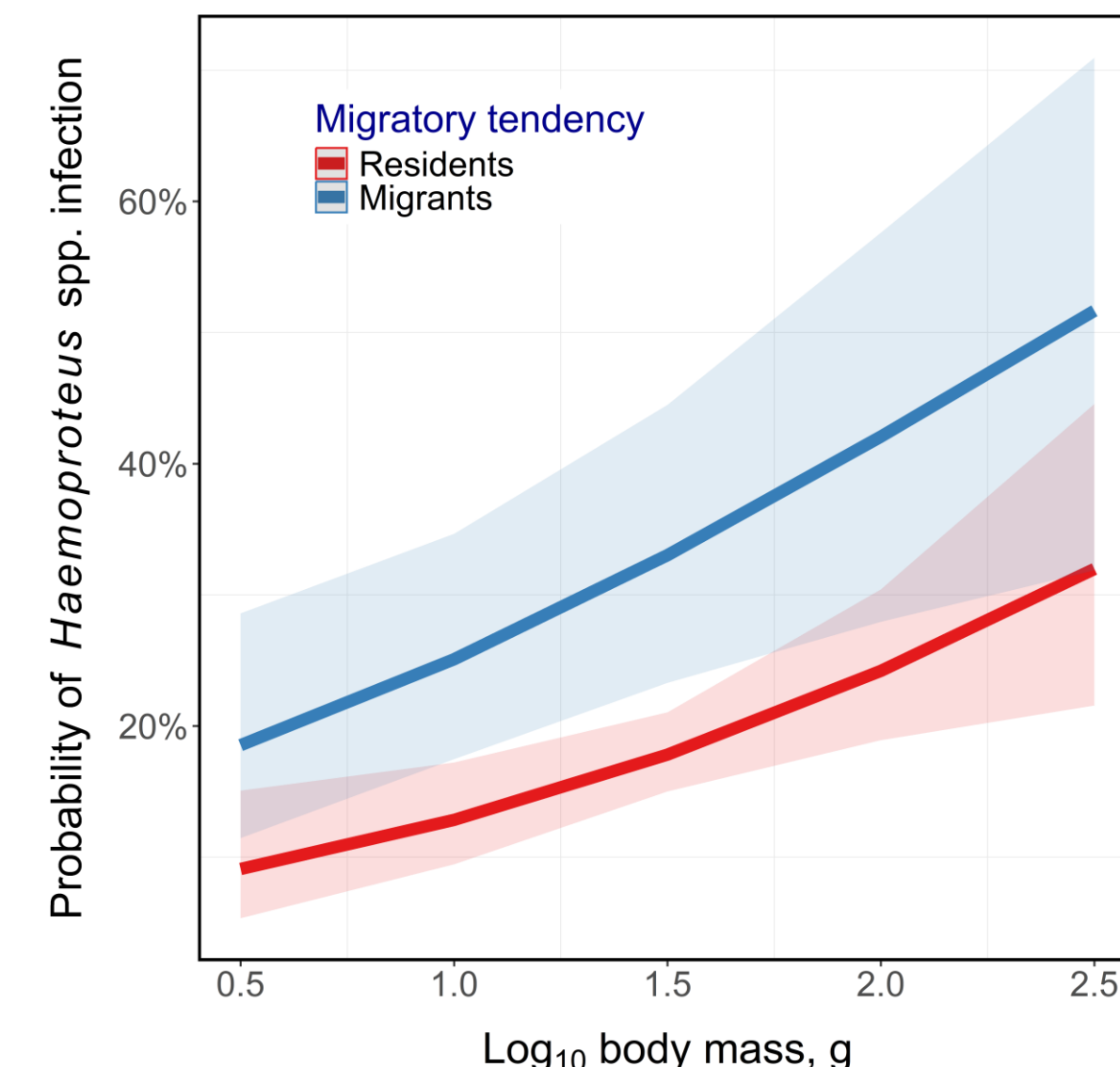


Fig. 4. The model-predicted probability of detecting *Haemoproteus* spp. in the blood of tropical migrants and residents as a function of body mass.



RESULTS

- *Haemoproteus* spp. were detected in 19.1% of blood smears (see Fig. 2 for the histogram of parasite load in infected birds).
- Among sedentary birds, suboscine passerines exhibited significantly lower *Haemoproteus* spp. parasitemia compared to oscines and non-passerines (Fig. 3). Differences between these three groups were statistically significant.
- Migratory species were more likely to be infected with *Haemoproteus* spp. than sedentary species (Fig. 4). In both groups, this likelihood increased with body mass (Fig. 4).
- In a model considering three main taxonomic groups (oscines, suboscines, and non-passerines), the intensity of *Haemoproteus* spp. parasitemia was positively associated with mass-independent BMR.
- Among passerines, infestation by louse flies and Amblycera lice was negatively associated with *Haemoproteus* spp. parasitemia, whereas infestation by Ischnocera lice was positively associated.
- The H/L ratio was not significantly related to *Haemoproteus* spp. parasitemia.

CONCLUSIONS

- Even among sedentary tropical passerines, suboscines of the Old World (Tyranni: Eurylaimides) exhibit slower life-history traits, as indicated by their lower BMR and stronger immune defenses. These traits may represent one of the few advantages of suboscines, a group that has been largely outcompeted by oscines in the Old World.
- The higher prevalence of *Haemoproteus* spp. in long-distance migrants may be related to the greater diversity of habitats encountered throughout their lives and/or their less reliable immune defenses. Physiological trade-offs likely prevent wintering migrants from maintaining an immune system as robust as that of tropical residents.
- The absence of a relationship between the H/L ratio, a measure of long-term stress, and *Haemoproteus* spp. parasitemia suggests that the chronic stage of this blood parasite does not trigger a significant stress response in birds. However, the positive relationship between *Haemoproteus* spp. parasitemia and BMR indicates that combating this blood parasite constitutes some energetic cost in infected birds.