JOURNAL OF VETERINARY AND APPLIED SCIENCES
VOLUME 15, ISSUE 2: 1119 – 1125 (2025)
Published by: Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria
ISSN: 2315-6856; e-ISSN: 2636-5553; Website: www.jvasonline.com

A rare case of co-occurring reptilian malaria (*Plasmodium* spp), haemoproteosis (*Haemoproteus* spp) and ascariasis (*Ophidascaris* spp) in a royal python (*Python regius*)

Olanrewaju S. Olaifa [1], Abigail C. Abwage [2] *, Theophilus A. Jarikre [1], Olawale O. Ola [1], Fortunate N. Ogbonna [3] and Philip O. Ojo [3]

[1] Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Ibadan, Oyo State, Nigeria.

[2] Department of Forestry and Wildlife Management, Faculty of Agriculture, Taraba State University, Taraba State, Nigeria.

[3] Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, University of Ibadan, Oyo State, Nigeria.

==========

Abstract

Co-infections involving multiple haemoparasites in reptiles are rare in scientific literature, making each reported case highly valuable for advancing knowledge in reptile medicine. This present report presents, for the first time, a case of concurrent *Plasmodium* and *Haemoproteus* infections with *Ophidascaris* infestation in a captive royal python (*Python regius*) maintained at the Zoological Gardens, University of Ibadan, Nigeria. The affected python exhibited clinical signs of marked lethargy and complete anorexia, which progressed to a gradual deterioration in its health condition that eventually led to death despite supportive care. Haematological evaluation of the peripheral blood smear revealed numerous intra-erythrocytic haemoparasites. The morphological features observed under the light microscope were consistent with both *Plasmodium* and *Haemoproteus* species, indicating a mixed infection. This dual infection represents a significant diagnostic challenge, as clinical signs may overlap, and accurate species identification may often require advanced laboratory methods. Postmortem examination further revealed multiple systemic pathological changes. There were numerous roughly linear ulcerative lesions ranging from 1.5 to 5 cm in length surrounding the base of the tail, indicative of secondary complications. Additional gross pathological findings included generalized cachexia, marked pallor of the mucous membranes and skeletal musculature, severe coelomic effusion suggestive of systemic compromise. There was also a heavy gastrointestinal parasitism by adult *Ophidascaris* nematodes. This case highlights the importance of including haemoparasitic co-infections in the differential diagnosis of ill reptiles. Furthermore, it emphasizes the necessity for routine health monitoring and accurate parasite identification, which are critical for proper treatment, management, planning and advancement of the understanding of reptilian health challenges.

Keywords: Parasitism; Royal python; *Plasmodium* spp; *Haemoproteus* spp; *Ophidascaris* spp.; Co-infection and infestation.

* **Correspondence:** Abigail C. Abwage, Email: abwage.a@tsuniversity.edu.ng; Phone: +2347030482249

Article History: Initial manuscript submission received – June 17, 2025; Final revised form received – July 18, 2025; Accepted for publication – July 23, 2025; Published – August 15, 2025.

Introduction

Haemoparasitic infections are common among reptiles, particularly in the tropical environment. Reptilian haemoparasitic infections are primarily caused by protozoan parasites such as *Plasmodium* and *Haemoproteus* species, members of the phylum Apicomplexa and order Haemosporida (Telford, 2009). While extensively studied in mammals and birds, these parasites remain poorly characterized in snakes (Telford, 2007; Perkins, 2014).

Haemoproteus species, belonging to the family Haemoproteidae, are apicomplexan parasites traditionally associated with avian hosts but have been sporadically identified in reptiles, including snakes such as the royal python (*Python regius*) (Bakre *et al.,* 2024). The genus *Haemoproteus* comprises a diverse group of protozoa transmitted primarily by biting midges (*Culicoides* spp.) or louse flies in avian hosts. In reptiles, vectors are less well-defined but may include ticks and mites (Jacobson, 2007). The life cycle typically involves sporozoite transmission during vector feeding, exo-erythrocytic merogony in endothelial cells or fixed tissues, intra-erythrocytic gametocyte development, and uptake of gametocytes by the vector, completing the sexual cycle. Unlike *Plasmodium* species, *Haemoproteus* does not undergo erythrocytic schizogony, which contributes to its relatively milder pathogenicity profile in many hosts (Valkiūnas, 2005). Reptilian haemoproteosis presents a diagnostic challenge and may be under-reported due to sub-clinical manifestations and difficulty in species identification. Potential factors influencing the prevalence of haemoproteosis include geographical distribution of vectors, captive husbandry practices and contact with wild or infected feeder animals (Martins *et al.,* 2020).

Reptilian malaria is a vector-borne parasitic disease caused by protozoan parasites of the genus *Plasmodium*, which affects a wide range of reptilian hosts, including snakes such as pythons (Pythonidae family). Several species of *Plasmodium* have been identified in snakes, including *Plasmodium pessoai*, *Plasmodium wenyoni*, and *Plasmodium bitis* (Paperna and Landau, 1991; Telford, 2007). The life cycle of *Plasmodium* in pythons parallels that of mammalian malaria parasites but occurs in ectothermic vertebrate hosts and different vector species (Telford, 2007). Infection begins when a haematophagous arthropod, such as a mosquito, mite, or tick, feeds on an infected python, ingesting gametocytes. Inside the vector, gametocytes differentiate into gametes, undergo fertilization and form ookinetes that develop into oocysts. Sporozoites emerge from oocysts and migrate to the salivary glands, ready to infect a new host during the vector's subsequent blood meal (Perkins and Austin, 2009). Upon entering the python host, sporozoites invade hepatic tissues and begin asexual replication (exo-erythrocytic schizogony). Merozoites are subsequently released into the bloodstream, where they infect erythrocytes and continue asexual reproduction (erythrocytic schizogony), resulting in cycles of parasitaemia (Telford, 2009).

Pythons infected with *Plasmodium* spp. may exhibit a variety of clinical signs, depending on the intensity of infection and the host's immune response. Clinical manifestations have been reported to include anaemia, anorexia, lethargy, immunosuppression, and in severe cases, mortality (Telford, 2009; Perkins, 2014). However, many infections remain subclinical, especially in wild populations. The severity of the disease often correlates with parasite load, environmental stressors, concurrent infections and overall host health. Currently, no standardized treatment protocols exist for *Plasmodium* infections in pythons. Experimental treatments using anti-malarial drugs such as chloroquine or primaquine, commonly used in mammalian malaria, have shown variable

success and are not widely adopted in veterinary practice (Telford, 2009). Management strategies emphasize supportive care, reduction of environmental stress, nutritional support, and most importantly, vector control to prevent transmission (Telford, 2009). In captive populations, controlling exposure to mosquitoes and other blood-feeding arthropods remains the most effective preventive measure. Earlier reports of reptilian malaria involved lizards; infections in snakes, especially captive royal pythons are exceptionally rare.

Ophidascaris is a genus of nematodes belonging to the family Ascarididae. These helminths are commonly reported in snakes, particularly in pythons and other large-bodied serpents. *Ophidascaris* infestation in reptiles can lead to significant morbidity, particularly in captive environments where stress, diet, and hygiene issues can exacerbate pathogenicity. These parasites exhibit a direct life cycle or involve paratenic hosts (amphibians or small mammals), depending on the species. The eggs are shed via faeces and become infective in the environment, eventually being ingested by a suitable host. Upon ingestion, larvae migrate through tissues before maturing in the gastrointestinal tract (Rataj *et al*., 2011). Infected hosts may exhibit a range of clinical signs including anorexia, regurgitation, abdominal swelling, intestinal obstruction, weight loss, and lethargy. Gross lesions associate with the infestation typically involves the gastrointestinal tract, where adult nematodes may cause mechanical damage, inflammation, and even perforation (Jacobson, 2007). In severe infestations, systemic migration can occur, with larvae found in hepatic, pulmonary, or muscular tissues (Kik *et al*., 2011). Secondary bacterial infections may further complicate the clinical picture. Histopathologically, affected tissues may show granulomatous inflammation, necrosis, and eosinophilic infiltration due to larval migration. *Ophidascaris* infestation is of both veterinary and zoonotic concern, especially in reptiles (including the royal python) kept in herpetoculture collections.

The royal python (*Python regius*), a non-venomous constrictor native to West and Central Africa, commonly kept in captivity in zoological gardens and in herpetoculture collections, may become vulnerable to vector-borne parasitic infections under various conditions (Jacobson, 2007). The present case being reported is therefore particularly relevant to private herpetoculture and exotic pet medicine. This report documents a rare co-infection with both *Plasmodium* spp. and *Haemoproteus* spp., and infestation with *Ophidascaris* spp. in a captive royal python.

Case Presentation

Patient History: An adult male royal python (*Python regius*), approximately two years in captivity, was found dead on May 19, 2025, following a week-long history of progressive lethargy and anorexia. Forced feeding was attempted two days prior to death, involving the ingestion of a single chick.

Postmortem Findings: The carcass was moderately emaciated (Figure 1). Externally, multiple roughly linear ulcerative lesions ranging from 1.5 to 5 cm in length, were observed surrounding the base of the tail (Figure 2). Examination of the mucous membrane and skeletal musculature revealed generalized pallor (Figure 3). The coelomic cavity was markedly distended, particularly in the distal third of the body, with a soft, “doughy” texture on palpation. Upon opening, a large volume of clear, straw-coloured fluid of about 90 ml was present within the coelomic cavity. The gastrointestinal tract contained a whole undigested chick lodged in the stomach. Additionally, 2 - 5 adult nematodes collected from the gastrointestinal tract were identified as *Ophidascaris* species, a host-specific parasitic genus commonly found in royal

pythons. The caecum harboured five large impacted faecal masses, each weighing between 5.0 and 9.2 g (gastrointestinal stasis or obstruction). The terminal portion of the gastrointestinal tract demonstrated a straw-yellow discolouration of both the mucosa and luminal contents.

Figure 1. Generalized emaciation of the royal python.

Figure 2. Linear ulcerative lesions observed at the base of the tail of the royal python.

Figure 3. Generalised pallor of the mucosa and skeletal musculature of the carcass of the royal python, indicating severe anaemia.

Laboratory Findings: Evaluation of stained peripheral blood smear revealed numerous intra-erythrocytic haemoparasites, morphologically consistent with *Haemoproteus* species (1 – 2 per high power field) (Figure 4) and *Plasmodium* species (3 – 5 per high power field) (Figure 5).

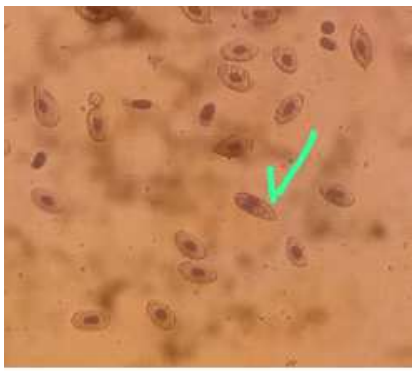

Figure 4. Stained thin blood smear made from blood collected from the royal python, showing intra-erythrocytic parasite (green arrow) suggestive of *Haemoproteus species* [Giemsa Wright stain, ×200].

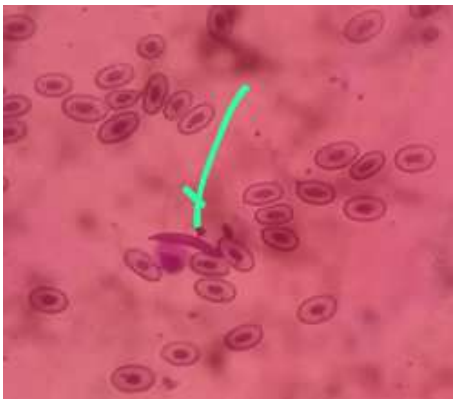

Figure 5. Stained thin blood smear made from blood collected from the royal python, showing the extracellular stage of *Plasmodium species* (green arrow) [Giemsa Wright stain, ×200].

Haematological evaluation showed the packed cell volume (PCV) was profoundly low (7%), signifying severe anaemia. Total plasma protein was 3 – 4 g/dl indicating hypoproteinaemia. The total white cell count was 14,000/µl, with a differential leukocyte count of 60% heterophils, 32% lymphocytes, 3% monocytes and 5% eosinophils.

Coelomic Fluid Analysis: The aspirated coelomic fluid was translucent and straw-coloured with a slightly acidic pH. Semi-quantitative biochemical analysis of the fluid using Uriscan 10S® (Randox Laboratories Ltd, Crumlin, County Antrim, UK) showed that it contained moderate levels of bilirubin and ketones and was weakly positive for nitrites. The specific gravity of the fluid was 1.010, with total protein concentration indicating a low protein content transudate. Cytological assessment of the coelomic fluid demonstrated that it was hypocellular, consistent with a non-septic, low protein content effusion.

Diagnosis

Haemoparasitism (reptilian malaria with haemoproteosis) and ascariasis (*Ophidascaris spp).*

Discussion and Conclusion

Haemoparasitic co-infections can exacerbate clinical disease and complicate management (Telford, 2009; Jacobson, 2007). In the present case, peripheral blood smear revealed intra-erythrocytic haemoparasites identified as *Plasmodium* spp. and *Haemoproteus* spp. These parasites are known etiological agents of reptilian malaria and haemoproteosis, respectively. Jointly, these parasites likely contributed significantly to the severe anaemia, hypoproteinaemia and debilitation recorded in the present case. Intra-erythrocytic schizogony and destruction of erythrocytes by both parasites may have been what led to the anaemia. Reports from available literature show that *Haemoproteus* infection is often less pathogenic than infection with *Plasmodium*, but clinical disease may exacerbate when co-infections occur (Telford, 2009).

The presence of multiple adult *Ophidascaris* spp. nematodes may have contributed to gastrointestinal dysfunction. Their chronic irritation of the gastrointestinal mucosa may have predisposed to mal-absorption, gastrointestinal stasis, impaction and obstruction (undigested chick, fecal masses). The undigested chick found within the stomach points to possible functional obstruction partly attributable to the forced feeding. Coercive feeding has reportedly been a known stressor that can precipitate regurgitation or incomplete digestion in compromised snakes (Jacobson, 2007).

Faecoliths, also known as fecal impactions or coproliths, are hardened masses of desiccated faecal material that can become lodged in the gastrointestinal tract, particularly in the colon or cloaca of reptiles. In captive pythons, faecolith formation can result in significant gastrointestinal obstruction, leading to anorexia, lethargy, and coelomic fluid accumulation (Stahl, 2014). This possibly explains the clinical manifestations of

anorexia, lethargy, and coelomic fluid accumulation as seen in the present case. The accumulation of straw-colored, low protein content fluid (transudate) within the coelomic cavity suggests hypoproteinemia-induced oncotic imbalance and/or hypovolemic shock. The fluid analysis indicated a non-septic process, aligning with malnutrition, chronic disease, and circulatory compromise (Hernandez-Drivers and Cooper, 2000).

The linear ulcerative lesions observed at the skin of the base of the tail in the present case is consistent with blister disease, often resulting from poor husbandry, high humidity and unsanitary substrate, compromised immunity. Secondary infections of such ulcers may have further exacerbated the snake's debilitated condition. The cumulative effect of anaemia, hypoproteinaemia, impaired gastrointestinal function, and systemic parasitism likely precipitated terminal hypovolemic shock, leading to death.

Earlier reports show that treatment of reptilian haemoparasite infections remain a challenge, as evidence-based protocols for haemoparasite infections in snakes are lacking, and supportive care and vector control remain central to its management (Jacobson, 2007). This present case exemplifies the multi-factorial nature of reptile morbidity in captive conditions, where infectious, parasitic, nutritional and husbandry factors interact synergistically to compromise health. This royal python's death is believed to be as a result of the combined effects of haemoparasitism, ascariasis and gastrointestinal obstruction.

Acknowledgements

The authors express their gratitude to the management and staff of Veterinary Teaching Hospital, University of Ibadan, Nigeria especially the Clinical Pathology Unit of the Hospital for providing the facilities and support essential for this report. Dr. B. N. Ogunro is being specially appreciated for his contribution towards the disease diagnosis.

Conflict of Interest

The authors declare no conflict of interest.

References

Bakre AA, Jarikre TA, Ola OO, Olaifa OS and Adebiyi TK (2024). Haemoproteus species infection and Blister disease in a captive royal python (*Python regius*): A case report. *Animal Research International*, 21(3): 5808 – 5812.

Hernandez-Divers SJ and Cooper JE (2000). *Reptile Medicine and Surgery.* WB Saunders, Philadelphia, USA.

Jacobson ER (2007). Infectious Diseases and Pathology of Reptiles: Color Atlas and Text. CRC Press, Boca Raton, Florida, USA.

Kik MJL, Janssen L and Borel N (2011). Granulomatous hepatitis due to *Ophidascaris* sp. in a Boa constrictor. *Journal of Comparative Pathology,* 145(2-3): 251.

Martins LA, Simko RT and Jacobson E R (2020). Hemoparasites of reptiles in captivity: clinical significance and diagnostic challenges. *Journal of Herpetological Medicine and Surgery*, 30(1): 23 – 31.

Paperna I and Landau I (1991). *Plasmodium pessoai* from the python (*Python molurus bivittatus*). *Annales de Parasitologie Humaine et Comparée,* 66(5): 246 – 248.

Perkins SL (2014). Malaria's many mates: past, present, and future of the systematics of the order Haemosporida. *Journal of Parasitology,* 100(1): 11 – 25.

Perkins SL and Austin CC (2009). Four new species of *Plasmodium* from New Guinea

lizards: integrating morphology and molecules. *Journal of Parasitology,* 95(2): 424 – 433.

Rataj AV, Lindtner-Knific R, Dovc A and Vergles Rataj M (2011). Parasites in reptiles. *Acta Veterinaria Scandinavica, 53, 33.*

Stahl SJ (2014). Clinical management of gastrointestinal disease in reptiles. *Journal of Exotic Pet Medicine*, 23(1): 42 – 52.

Telford SR Jr. (2007). *Plasmodium* (Apicomplexa: Plasmodiidae) species of snakes: taxonomic review and phylogenetic analysis. *Journal of Parasitology,* 93(6): 1184 – 1198.

Telford SR Jr. (2009). Haemoparasites of the Reptilia: Color Atlas and Text. CRC Press, Boca Raton, Florida, USA.

Valkiūnas G (2005). Avian Malaria Parasites and other Haemosporidia. CRC Press, Boca Raton, Florida, USA.