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Taxonomic description of new species *Diplotriaena Sarmasti n.sp.* (Nematode: Filariidae) in Jungle Mynas (*Acridotheres fuscus*) Wagler, 1872 (Passeriformes: Sturnidae) from District Larkana, Sindh, Pakistan

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ABSTRACT

Nematodes that recycle nutrients, govern pests, and offer data regarding the wellness of the soil, rendering them vital for both the environment and the soil. The crop yield, nematode management, gastrointestinal nematodes, predatory nematodes, entomopathogenic nematodes, nutrient cycling, soil quality and health indicators are all severely affected by worms. **Objectives:** To conduct zoological studies in District Larkana, Sindh, taxonomic sorting, or ecological research. Jungle mynas belong to the order Passeriformes, which are usually collected and preserved. **Methods:** The standard method employed for morphological analysis and ornithological research. Certain procedures are followed throughout the mynas' collection, preservation, and morphological examination to guarantee the credibility of this research while causing the least amount of injury to individual birds. The methods used differ depending on the study's goals and the ethical issues surrounding animal research. Mynas are a family of birds in the Passeriformes order. Frequently, investigations of them are conducted for zoological, taxonomic and ecological research studies. A new species of nematodes, *"Diplotriaena sarmasti n.sp"* documented in Jungle Mynas *"Acridotheres fuscus"* from the vicinity of Larkana, Sindh, Pakistan. **Results:** Overall, 25 nematodes (♂♂) were recovered from the body cavity of hosts. In the present study, nematodes reflected variations by their following characteristics viz: body dimensions, spicule shape and 23 to 24 pairs of caudal papillae. **Conclusions:** Therefore, these morpho-metrical changes are recommended as a new species and authoress devoted this species, *Diplotriaena sarmasti n.sp.*

INTRODUCTION

Nematodes have successfully adapted to virtually every ecosystem from freshwater to saltwater, from soils, from the Polar Regions to the tropics, and from the highest to the lowest elevations. They can be found in an extensive array of places, including mountains, deserts, and oceanic trenches. They are common in freshwater, marine, and terrestrial habitats, occasionally exceeding other animals in both individual and species counts. They are present in all regions of the Earth's lithosphere, including deep underground gold mines in South Africa, which lie 0.9–3.6 km (3,000–12,000 feet) below the surface of the planet [1]. They make up 90% of all creatures found on the ocean floor [2]. There are 4.4 × 1020 nematodes in the Earth's topsoil overall, or around 60 billion for every human, with the highest densities seen in boreal and arctic woods [3]. They play a significant role in many ecosystems due to their diversity of lifecycles, presence at different trophic levels, and numerical dominance, often surpassing a million individuals per square meter and making up almost 80% of all individual creatures on Earth [4]. In polar habitats, they are fundamental; there are 256 families among the approximately 2,271 genera [5]. Pathogens in the majority of plants and animals are among the numerous parasitic forms. About 35 nematode species are parasites of humans, and a third of the genera are found as vertebrate parasites [6]. Jungle myna (*Acridotheres fuscus*) Wagler is

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a myna found and distributed across the world, including Pakistan [7]. Characteristically, mostly found in cultivated areas such as forests, rice fields and near watery areas. They built their nest mostly in the palm trees and feed on a variety of food like several grains, fruits, insects, ticks and pests found in cattle and sheep. In many Asian countries, a variety of mynas, kept as pet birds. They have blackish heads and wings; grey fluff, bright yellow legs, and contain a forehead tuft on their heads and during flight, white patches are visible in their wings. The jungle mynas by nature are scavengers and omnivorous, and their stomach contains a variety of food contents, including beetles, termites, ants, caterpillars and fly larvae. Due to such type of feeding habits, they are more susceptible to parasitic infections. The Jungle Myna (*Acridotheres fuscus*) is a common bird species found in the tropical forests of Asia. Despite being considered an invasive species in some areas, the Jungle Myna plays a significant ecological role in its native habitats. The ecological importance of the Jungle Myna is a seed role as a seed dispersal agent. The Jungle mynas are known to feed on fruits, berries, and nectar, and in the process, they help disperse seeds of various plant species [8]. By scattering seeds, they contribute as well to the regeneration of forests. By ensuring the diversity of plant species, they aid in the regeneration of forests [9]. They demonstrate insectivorous behaviour as a means of controlling insects. Jungle Mynas help to control their populations by consuming insects, notably pests that harm crops [10]. Jungle Mynas promotes the ecological equilibrium by moderating insect populations, which keeps any one species from taking over the ecosystem [11]. Like other birds, Jungle mynas use their droppings as a natural fertilizer to move nutrients from one place to another [12]. Jungle Mynas droppings can improve soil quality, fostering the growth of crops and safeguarding the health of the ecosystem [13]. Using twigs, leaves, and other plant-based materials, they create nests that can serve as habitat for insects and small reptiles, among other vertebrates [14]. Jungle mynas' nesting habits provide the ability to alter their environment and produce microhabitats that encourage biodiversity [15]. A prevalent bird species in Asia's tropical jungles is the Jungle Myna (*Acridotheres fuscus*). The Jungle Myna, a member of the starling family, is a significant biological element within its natural setting. Jungle Myna's significance biologically includes: its food source, ecological niche, predator-prey dynamics, and ecosystem engineering. Their appetite for insects, such as caterpillars, grasshoppers, and beetles, aids in population control [16]. They modify local predator-prey dynamics by grazing on small animals like rodents, lizards, and snakes. Furthermore, these people were preyed upon by other creatures of all kinds, such as monkeys, snakes, and eagles, illustrating the complex connections found in ecosystems [17]. As omnivores, jungle mynas fill an ecological niche by devouring an abundance of foods, including fruits, seeds, and insects [18]. They are remarkably adaptive, blossoming in many different kinds of settings, from urban settings to jungles and enduring a wide range of environmental constraints [19]. For a variety of reasons, nematodes and parasitic infections frequently connect with avian hosts, or birds: Over millions of years, nematodes and birds co-evolved, resulting in intricate host-parasite relationships [20]. Due to their common past with nematodes, several bird species are more vulnerable to infection [21]. Birds are more likely to become infested because they frequently reside in areas where nematodes are present [22]. Infection may result from nematodes that birds obtain through their diet, such as insects or worms [23]. In light of their specialized antibodies, birds may be more exposed to nematode infections. The avian gastrointestinal tract provides a suitable environment for nematodes to establish themselves. A nematode parasite that infects chickens and other birds, causing gastrointestinal problems [24]. A nematode parasite that infects birds, causing respiratory problems [25]. A genus of nematodes that infect birds, causing gastrointestinal and respiratory problems [26].

This study aimed to present the first time, a new species of *Diplotriaena sarmasti n.sp* reported in the Jungle Myna District, Larkana, Sindh, Pakistan.

METHODS

In the present study, field observations were made on a total of seventy Jungle myna (*Acridotheres fuscus*) collected from the locality of Larkana, Sindh, Pakistan. Capture Techniques: The nets are frequently positioned where mynas are known to roost or feed. Fine nets were utilized to catch birds without hurting them physically. Traps: Researchers also employed automatic traps to capture several birds at once. Hand Capture: In certain situations, skilled people might be able to capture birds manually, especially if they have become accustomed to people. Handling: To prevent stress or harm, captured mynas are handled carefully. To minimize the effects on the health of the bird, appropriate field protocols are followed. Preservation of Mynas Euthanizing: According to ethical standards, a bird may be humanely put down if the researcher desires a specimen to be mounted or safeguarded for comprehensive morphological inspection. Taxidermy: Taxidermy can be done for specimens that are meant to be on display or in collections. This entails delicately skinning and mounting the birds and then properly preserving them (Freezing). Morphological Analysis Techniques and External Morphological Measurements: Researchers frequently measured multiple exterior traits, such as notably body mass, tarsus length, tail length, wing length, and bill length.

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Morphometric Analysis: To evaluate distinctions across populations or species, morphometric analysis uses quantitative metrics such as size and form. The data were then interpreted using statistical methods. Skeletal Analysis: In certain instances, the skeleton may be sanitized for determining osteological traits or analyzed post-mortem to perform further morphological analysis. Mynas may be frozen for genetic research to preserve its biological elements, notably DNA. Preservation Techniques and Alcohol Preservation: To keep smaller specimens from decomposing and to preserve their cellular features, they can be preserved in ethanol or isopropyl alcohol (Preservation Techniques). Alcohol Preservation: To stop disintegration and preserve cellular attributes, smaller specimens can be stored in ethanol or isopropyl alcohol. Drying: If preparing for a museum specimen, the bird may be dried and stored in a dry environment to prevent mold or rot. Overall, 25 nematode (♂♂) specimens were recovered from hosts. Recorded nematodes were killed in (70%) alcohol, cleared by applying the procedure of lactophenol and glycerol solution and alcohol- glycerol solution was used for their preservation. Their illustrations were completed under Camera Lucida by applying the procedure of (Garcia and Ash 1979) [27]. The collected mynas were anaesthetized and autopsied to examine helminth parasites. Photographic Techniques: For further investigation and reporting of apparent features, high-resolution photos may be gathered. Formalin fixation: A common method for preserving nematodes, involving fixation in a formalin solution (10% formalin in water) [28]. Glycerin fixation: A method used for preserving nematodes for microscopic examination, involving fixation in a glycerin solution [29]. Glycerin preservation: Nematodes can be preserved in glycerin (70-80% glycerin in water) for long-term storage [30]. Ethanol preservation: Nematodes can be preserved in ethanol (70-80% ethanol in water) for long-term storage [31]. By considering these ethical principles, researchers can ensure that their sample collection of nematodes is responsible, sustainable, and respectful of the environment, animals, and indigenous communities. Family: *Diplotriaenidae* [32]. Species: *Diplotriaena sarmasti n.sp.* Host: Jungle Myna (*Acridotheres fuscus*). Number of specimens examined (Twenty-five). Number of hosts found positive: (Five). Parasites recovered from the host. Locality: Vicinity of District Larkana. The author dedicated a new species in honors of her beloved Mother, Late Miss Fahmida Soomro.

RESULTS

Results for *Diplotriaena* Railliet" and "Henry, 1909" species recorded out of host are shown (Table 1).

Table 1: Shows Relative Characters of Genus "*Diplotriaena* Railliet" and "Henry, 1909" Species Recorded Out of Host

Parameters	Present Species (mm)	*D. niltavae*	*D. tristisi*	*D. bargusinica*	*D.almoraensis*
Body Length and Width	12. 43 x 0.31	24.0-24.4 x 0.496-0.512	32.94 x 0.455	31.0-46.4 x 0.72-0.77	39.2 x 0.32
Trident Dimension L and W	0.14 x 0.15	0.128 to 0.144	0.13	0.13 to 0.14	0.16
Numbers Caudal Papilla	23-24 Pairs	N.D	09	01	05
Dimension L and W Left Spicules	01.64	0.656 to 0.720	02.39	0.64 to 0.66	0.84 to 1.07
Dimension L and W Right Spicules	0.32	0.46 to 0.49	0.58	0.38 to 0.5	0.44 to 0.56
Parasite Host	*Acridotheres fuscus*	*Niltava grandis*	*Acridotheres tristis*	*Turdus roficollis*	*Parus major*
Parasite Locale	Physique Cavities	Physique Cavities	Physique Cavities	Physique Cavities	Physique Cavities
Areas/ Vicinities	Vicinity of District Larkana	(Uttarakhand, India)	(Burdwan)	(Bhutan)	Uttarakhand, India

Whereas, N. D denotes not detectable. Measurements are presented in millimetres (mm). Dimension: L denotes length and W denotes Width.

The body of the recovered nematode was elongated, thick, and highly muscular, with a length measurement of (12.43-12.47 mm) and a width of (0.31-0.26) mm wide and the anterior-posterior side was round in type. Two unequal-sized tridents, one with a rounded tip and the other with a pointed tip, were examined. They possessed unequal prongs in left and right trident, the length was measured (0.14 to 0.11 mm) and (0.15 to 0.07 mm) wide. (♂♂) made with the help of a camera Lucida a. Anterior section showing two prominent tridents of unequal size, with Scale bar: (0.2) mm (Figure 1).

Figure 1: Illustration of Nematode (*Diplotriaena sarmastini sp*)

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During examination it was observed that, their close-fitting right spicules projected outside to the posterior bearing slight curve with a measurement of (1.64 mm) in length and small in size than the left spicules jutted outside to posterior apex bearing large curve projected towards the downward with a measurement of (0.32 mm) in length. Posterior section showing two spicules, one larger other smaller, with scale bar (0.2) mm (Figure 2).

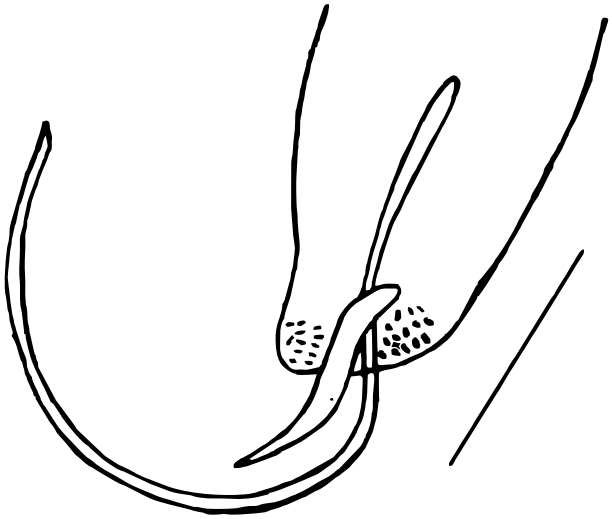

Figure 2: Posterior Section Showing Two Spicules, One Larger Other Smaller, with Scale Bar

A photography of the anterior section showing the tridents of Diplotriaena sarmasti n.sp(♂♂)(Figure 3).

Figure 3: *Diplotriaena Sarmasti n.sp.* (♂♂). Photography of Anterior Section

Photography of the posterior section showing the two spicules right spicule is shorter and the left spicule is larger (Figure 4).

Figure 4: Photography of the Posterior Section

DISCUSSION

Worldwide and at national level, a very insufficient species of Genus *Diplotriaena* has been described which include (*D. sternopastori*). *Myiophoneus caeruleus temmincki* differed from present species (*Diplotriaena sarmasti*) have large sized length and broader width; equal prongs of trident observed have been observed, larger left spicule and smaller right spicule. Study documented in Zoothra citrine of Uttara-khand differed from current species (*Diplotriaena sarmasti*) with large sized length, maximum body width; trident with equal prongs having pointed tips, unequal right and left spicules [33], *Niltava grandis* differed from the current species (*Diplotriaena sarmasti*) with greater body length, maximum width; equal trident prongs with small in length; the left spicule was large as compared with right spicule, *D. almoraensis* differed from the present species (*Diplotriaena sarmasti*) have large body lengths, maximum width; equal trident prong and large sized length; left spicule larger than right spicule, Turdus ruficollis of Bhutan which differed from present species (*Diplotriaena sarmasti*) having large sized body length and broader width; the tridents were small in length with unequal spicules [33]. *D. nagpurensis* documented in *Acridotheres tristis* of Nagpur which differed from the current species (*Diplotriaena sarmasti*) with large sized length, maximum body width; large tridents; unequal spicules. *D. tricuspis* in *Acridotheres tristis* of Nagpur which differed from the present species (*Diplotriaena sarmasti*) with large sized specimens; smaller tridents, and unequal both spicules. *D. bhamoensis* reported in *Ethiopsar albocinclus* which differed from the (*Diplotriaena sarmasti*) which have large sized body length and maximum body width. *D. graculi* verified in *Pyrrhocorax* of Calcutta which differed from (*Diplotriaena sarmasti*) which have large sized body length, maximum width and unequal spicules. *D. dubia* chronicled in *Pyrrhocorax* of Calcutta which differed from (*Diplotriaena sarmasti*) which have larger length with maximum body width; left spicule recoded as large in length and right

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spicule is small. *D. urocissae* reported in *Urocissa flavirostris* of Calcuta which differed from (*Diplotriaena sarmasti*) with large sized body and broader width; left spicule recoded large whereas right spicule small in length [34]. (*D. lagopusi*) documented in White-tailed ptarmigan (*Lagopus leucurus*) of Central and Northern Colorado, USA which differed from the current species (*Diplotriaena sarmasti*) which have large sized body length and broader width; small trident, unequal spicule [35], (*D. andersoni*) reported in White-tailed ptarmigan (*Lagopus leucurus*) from Canada which differed from the present species (*Diplotriaena sarmasti*) which have large sized body length and broader width and unequal spicule [35], Present recorded species (*Diplotriaena sarmasti*) differ from the aforementioned species in length, width, tridents, right and left spicules, showing complete disparity at the morphological. Therefore, identified as a new species, which is a new contribution in the field of parasitology and taxonomy.

CONCLUSIONS

It was concluded that the species documented in current studies reflects variation from earlier described allies of nematodes about the following characteristics, such as dimensions of body, shape of tridents and spicules, with the occurrence of 23 to 24 pairs of caudal papillae. Therefore, such morpho-metrical variations are measured as a new species, Diplotriaena sarmasti, contributing a new addition to the domain of taxonomy and parasitology.

Authors Contribution

Conceptualization: BS, SAM
Methodology: SAM
Formal analysis: BS
Writing review and editing: BS, SAM

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

[1] Dayi M. Evolution of Parasitism Genes in the Plant Parasitic Nematodes. Scientific Reports. 2024 Feb; 14(1): 3733. doi: 10.1038/s41598-024-54330-3.

[2] Worm B and Lotze HK. Marine biodiversity and climate change. In Climate Change. 2021 Jan: 445-464. doi: 10.1016/B978-0-12-821575-3.00021-9.

[3] Van Den Hoogen J, Geisen S, Routh D, Ferris H, Traunspurger W, Wardle DA *et al.* Soil Nematode Abundance and Functional Group Composition at A Global Scale. Nature. 2019 Aug; 572(7768): 194-8. doi: 10.1038/s41586-019-1418-6.

[4] Ridall A and Ingels J. Suitability of Free-Living Marine Nematodes as Bioindicators: Status and Future Considerations. Frontiers in Marine Science. 2021 Jul; 8: 685327. doi: 10.3389/fmars.2021.685327.

[5] Siegert MJ and Fountain AS. Evolution of the Antarctic Continent and Its Ice Sheet. Cambridge History of the Polar Regions. 2023 May: 55-78. doi: 10.1017/9781108555654.003.

[6] Qing X, Zhang YM, Sun S, Ahmed M, Lo WS, Bert W *et al.* Phylogenomic Insights into the Evolution and Origin of Nematoda. Systematic Biology. 2024 Dec: syae073. doi: 10.1093/sysbio/syae073.

[7] Gill F, Donsker D, Rasmussen P, Editors. IOC World Bird List. International Ornithological Committee. 2021.

[8] Corlett RT. Frugivory and Seed Dispersal. In Plant-Animal Interactions: Source of Biodiversity. Cham: Springer International Publishing. 2021 May: 175-204. doi: 10.1007/978-3-030-66877-8_7.

[9] Mariyappan M, Rajendran M, Velu S, Johnson AD, Dinesh GK, Solaimuthu K *et al.* Ecological role and Ecosystem Services of Birds: A Review. International Journal of Environment and Climate Change. 2023; 13(6): 76-87. doi: 10.9734/ijecc/2023/v13i61800.

[10] Dinesh GK, Priyanka B, Anokhe A, Ramesh PT, Venkitachalam R, Sri KK *et al.* Ecosystem Services and Ecological Role of Birds in Insect and Pest Control. Plant Protection: From Chemicals to Biologicals, 1st Ed. De Gruyter, Berlin. 2022 Oct; 623. doi: 10.1515/9783110771558-018.

[11] Gaston KJ. Birds and Ecosystem Services. Current Biology. 2022 Oct; 32(20): R1163-6. doi: 10.1016/j.cub.2022.07.053.

[12] Hite JL, Pfenning-Butterworth A, Auld SK. Commentary: Infectious Disease—The Ecological Theater and the Evolutionary Play. Evolutionary Ecology. 2023 Feb; 37(1): 1-1. doi: 10.1007/s10682-023-10229-5.

[13] Aikins TK, Thomson RL, Cramer MD. All Savanna Islands of Fertility Are Not Equal: Colonial Birds Influence Soil Nutrient Stoichiometries with Consequences for Tree Seedling Growth. Plant Ecology. 2023 Aug; 224(8): 685-96. doi: 10.1007/s11258-023-01333-1.

[14] Mainwaring MC, Stoddard MC, Barber I, Deeming DC, Hauber ME. The Evolutionary Ecology of Nests: A Cross-Taxon Approach. Philosophical Transactions of the Royal Society B. 2023 Aug; 378(1884): 20220136. doi: 10.1098/rstb.2022.0136.

DOI: https://doi.org/10.54393/mjz.v5i03.137

[15] Mainwaring MC, Medina I, Tobalske BW, Hartley IR, Varricchio DJ, Hauber ME. The Evolution of Nest Site Use and Nest Architecture in Modern Birds and Their Ancestors. Philosophical Transactions of the Royal Society B. 2023 Aug; 378(1884): 20220143. doi: 10.1098/rstb.2022.0143.

[16] Gaston KJ. Birds and Ecosystem Services. Current Biology. 2022 Oct; 32(20): R1163-6. doi: 10.1016/j.cub.2022.07.053.

[17] Sherry TW. Sensitivity of Tropical Insectivorous Birds to the Anthropocene: A Review of Multiple Mechanisms and Conservation Implications. Frontiers in Ecology and Evolution. 2021 May; 9: 662873. doi: 10.3389/fevo.2021.662873.

[18] Dayananda SK, Perera SJ, Senevirathne SS, Kotagama SW. Diversity, Distribution, and Biogeography of Sri Lankan Birds. In Biodiversity Hotspot of the Western Ghats and Sri Lanka. 2024 Feb: 565-598. doi: 10.1201/9781003408758-30.

[19] Salsabila N, Bekti NS, Widiyono I. Nematode and Coccidia Infections in Singing Birds Kept in Bird Stalls. In IOP Conference Series: Earth and Environmental Science. 2023 May; 1174(1): 012014. doi: 10.1088/1755-1315/1174/1/012014.

[20] Islam MR, Bhuiyan MA, Begum A, Jhinu ZN. Avian Nematode Parasites of Some Wild Birds of Bangladesh. Bangladesh Journal of Zoology. 2024 Jul 11;52(1):39-55. doi: 10.3329/bjz.v52i1.74725.

[21] Kuklin VV. Biogeographical Aspects of Helminths Parasitizing Barents Sea Birds: Spatial Distribution and Host Preferences. Biology Bulletin. 2022 Dec; 49(9): 1570-92. doi: 10.1134/S1062359022090175.

[22] Marcogliese DJ. Major Drivers of Biodiversity Loss and Their Impacts on Helminth Parasite Populations and Communities. Journal of Helminthology. 2023 Jan; 97: e34. doi: 10.1017/S0022149X2300010X.

[23] Pfenning-Butterworth A, Buckley LB, Drake JM, Farner JE, Farrell MJ, Gehman AL *et al*. Interconnecting Global Threats: Climate Change, Biodiversity Loss, and Infectious Diseases. The Lancet Planetary Health. 2024 Apr; 8(4): e270-83. doi: 10.1016/S2542-5196(24)00021-4.

[24] Arriero E, Pérez-Tris J, Ramírez A, Remacha C. Trade-Off Between Tolerance and Resistance to Infections: An Experimental Approach with Malaria Parasites in A Passerine Bird. Oecologia. 2018 Dec; 188: 1001-10. doi: 10.1007/s00442-018-4290-4.

[25] Qamar MF, Abbas RZ, Zaman MA, Atif AK. Molecular Detection of Fancy Birds Parasites for Clinical Diagnosis and Epidemiology Review. The Journal of Veterinary Medicine and Animal Sciences. 2021; 4: 1089.

[26] Anderson RC. Nematode Parasites of Vertebrates: Their Development and Transmission. Centre for Agriculture and Biosciences International. 2000 Feb. doi: 10.1079/9780851994215.0000.

[27] Nikolopoulou K. In Light of Myth: Photography as Truth in Roland Barthes's Camera Lucida. Textual Practice. 2024 Sep; 38(9): 1492-512. doi: 10.1080/0950236X.2024.2379187.

[28] Nickle WR. Methods for Collection and Preparation of Nematodes. Manual of Agricultural Nematology. 2020 Dec: 75-124. doi: 10.1201/9781003066576-3.

[29] Shokoohi E. Methods and Techniques in Nematology. Bentham Science Publishers. 2025 Mar. doi: 10.2174/9789815313680125010l.

[30] Andaló V, Cavalcanti RS, Molina Acevedo JP, Moino Junior A. Evaluation of Potential Preserving Substances for the Storage of Entomopathogenic Nematodes (Rhabditida: Steinernematidae, Heterorhabditidae). Arquivos do Instituto Biológico. 2021 Sep; 75: 301-12. doi: 10.1590/1808-1657v75p3012008.

[31] Hazir S, Kaya H, Touray M, Cimen H, Ilan DS. Basic Laboratory and Field Manual for Conducting Research with the Entomopathogenic Nematodes, Steinernema and Heterorhabditis, and Their Bacterial Symbionts. Turkish Journal of Zoology. 2022; 46(4): 305-50. doi: 10.55730/1300-0179.3085.

[32] Ferreira-Silva C, Alcantara EP, Avila RW, Silva RJ. A New Species of Hastospiculum Skrjabin (Spirurida: Diplotriaenidae) Parasite of Xenodon merremii (Walger in Spix) (Serpentes: Dipsadidae) from Northeastern Brazil. Zootaxa. 2020 Nov; 4878(2): zootaxa-4878. doi: 10.11646/zootaxa.4878.2.9.

[33] Soota TD, Srivastava CB, Ghosh RK. The Helminth Fauna of Andaman and Nicobar Islands: Trematoda. Records of the Zoological Survey of India. 1976; 67(1): 281-285. doi: 10.26515/rzsi/v67/i1-4/1972/161476.

[34] Chanu LB and Mohilal N. A Compendium of Aphelenchoides (Fischer, 1894) (Nematoda: Tylenchina: Aphelenchoidea) Nematodes with the Description of a New Species from Manipur, India. Journal of Threatened Taxa. 2023 Oct; 15(10): 24063-78. doi: 10.11609/jott.8420.15.10.24063-24078.

[35] Soomro B and Memon SA. Systematic Status of New Species of Diplotriaena murtazi n. sp. (Nematode: Filariidae) from Common Myna (Acridotheres tristis) Linnaeus, 1766 (Passeriformes: Sturnidae) in District Larkana, Sindh, Pakistan. Pakistan Journal of Nematology. 2023 Dec; 41(2).