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Original Article

First Report of Adult *Brachylaima* sp. (Digenea: Brachylaimidae) Parasitizing Wild Pigeons (*Columba livia*) in the United Arab Emirates

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Abstract

Background: We aimed to present the morphometric analysis of adult *Brachylaima* sp. infect wild pigeons, *Columba livia*, in the United Arab Emirates (UAE).

***Methods*:** *Brachylaima* sp. specimens were collected from the intestinal tracts of 5 *C. livia* in Al Ain City, UAE, from 2023 to 2024. After extraction and preservation in 70% ethanol, 15 specimens were stained with acetocarmine, dehydrated, cleared, and permanently mounted for detailed microscopic analysis. Their morphology was systematically measured and compared to existing data for other *Brachylaima* species.

***Results*:** The adult *Brachylaima* sp. revealed an elongated cylindrical body with rounded ends. Oral and ventral suckers were equally sized and muscular, with the oral sucker at the anterior end and the ventral sucker in the anterior body quarter. A short pre-pharynx led to a spherical pharynx, with no observed esophagus. Tubular digestive ceca bifurcated posterior to the pharynx, extending laterally to the body's terminus. Two oval, tandem testes occupied the posterior quarter, larger than the ovary positioned between them. A tubular cirrus pouch and seminal vesicle lay anterior to the anterior testis. A small seminal receptacle adjoined the ovary's posterior margin. The uterus formed a convoluted loop ascending toward the pharynx before descending to a genital pore near the anterior testis, filled with ovoid operculated eggs. Vitelline follicles spanned bilaterally from the ventral sucker to the anterior testis. The excretory ducts are connected to a tubular vesicle between the ceca, ending in a subterminal pore.

***Conclusion*:** Given the medical importance of *Brachylaima*, further experimental and molecular studies are critical to resolve its taxonomy, life cycles, and transmission dynamics in arid ecosystems.

Introduction

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The trematode family Brachylaimidae comprises 7 genera and over 70 species of endoparasites, utilizing vertebrates as definitive hosts (1, 2), while the terrestrial snails/slugs as first and/or second intermediate hosts (3-5). Adult *Brachylaima* spp. inhabits the digestive tracts of vertebrate definitive hosts, releasing eggs that exit the host via feces, and when land snails (first intermediate hosts) ingest these eggs, they develop into sporocysts within the snail's hepatopancreas (5-7). Infected snails subsequently produce cercariae, which are expelled encapsulated within mucus secretions, and they actively invade a second intermediate host snail, where they migrate to the kidney and mature into non-encysted metacercariae (7). The cycle concludes when a vertebrate host ingests the second infected snail, enabling the metacercariae to develop into adults within the digestive tract (6, 7). Globally distributed, *Brachylaima* spp. have been reported to parasitize a range of hosts, including humans, dogs, rats, chickens, doves, cuckoo and myna birds (8-15).

Pigeons, acting as hosts, are prone to infections by various pathogens. These include protozoans such as *Trichomonas gallinae*, *Toxoplasma gondii*, and *Cryptosporidium* spp.; nematodes like *Capillaria* spp., *Syngamus* spp., and *Ascaridia* spp.; platyhelminths such as *Raillietina* spp., *Hymenolepis* spp., *Echinostoma* spp. and *Brachylaima* spp.; and ectoparasites including ticks, mites, and lice (13, 16-20). Although adult *Brachylaima* spp. share consistent morphological traits at the species level, global research has documented regional differences in body size and internal organ morphology.

This study presents the first morphometric analysis of adult *Brachylaima* sp. collected from wild pigeons, *Columba livia*, in Al Ain City, United Arab Emirates (UAE), marking the first recorded occurrence of this trematode in the study area birds.

Materials and Methods

Study site

Al Ain, the UAE's largest inland city (coordinates: 24°11'30.012"N, 55°45'38.016"E), is home to approximately 645,000 inhabitants (21). Situated 160 km east of Abu Dhabi (the UAE's capital) and 120 km south of Dubai, the city lies within a hyperarid desert climate marked by sweltering summers, mild winters, and annual rainfall averaging 100-120 mm (22). Relative humidity typically hovers around 60%. Renowned for its extensive groundwater reserves, Al Ain leverages these resources to sustain agricultural irrigation and date palm cultivation, forming a vital component of its landscape and economy (23).

Sampling and trematode morphometrical analysis

Brachylaima sp. specimens were obtained from the intestinal tracts of wild pigeons (*C. livia*) during a parasitological survey of ecto- and endoparasites in Al Ain City, UAE (Aug 2023–Oct 2024). During the necropsy, the duodenum, ileum, and rectum were removed, dissected, and placed into individual Petri dishes filled with 0.9% saline solution. These intestinal sections were meticulously inspected under a stereomicroscope to identify parasites. Recovered trematodes were carefully extracted using Pasteur pipettes, counted, and stored in 70% ethanol for preservation. For morphological analysis, specimens were stained with acetocarmine, dehydrated through a graded ethanol series (70%–100%), cleared in xylol-methyl salicylate, and permanently mounted on glass slides. Key anatomical features, including oral and ventral suckers, pharynx, testes, ovary, cirrus pouch, and eggs, were measured in micrometers (µm), with both average dimensions and size ranges recorded. Observations were conducted using an Olympus CX33 light microscope equipped with an Olympus EP50 digital imaging system.

Ethical considerations

This research was conducted as part of a comprehensive study on ecto- and endoparasites in pigeon populations across Al Ain City, UAE. The project was carried out under Scientific Research No Objection Certificate No. 200100118, issued by the Environment Agency – Abu Dhabi, and received ethical approval from the Animal Use Ethics Committee at UAE University (Approval ID: ERA_2024_5106).

Results

Thirty-seven gravid adult *Brachylaima* sp. specimens were recovered from the rectums of 5 out of 50 examined wild pigeons (*C. livia*). Observations and morphometric data were recorded from 15 specimens of the trematode and the averages were compared to published measurements for other *Brachylaima* spp. (Table 1). The adult gravid trematode (Figs. 1 and 2) exhibited an elongated, cylindrical body with rounded anterior and posterior ends, measuring 4.7–5.0 mm long × 0.8–0.9 mm wide. Both the muscular oral and ventral suckers were spherical and subequal in size. The oral sucker, positioned anteriorly, was spherical (310–312 µm long × 279–283 µm wide), while the ventral sucker (315–318 µm long × 285–288 µm wide) occupied the anterior quarter of the body. A short pre-pharynx preceded the pharynx. Pharynx muscular and spherical (224–226 µm long × 200–207 µm wide). Esophagus absent. The digestive ceca were tubular, bifurcating postpharyngeally and extending laterally to the posterior terminus. Two smooth-margined, oval-shaped testes, positioned one behind the other and both larger than the ovary, were in the posterior quarter of the body between the intestinal ceca: the anterior testis measured 524–530 µm long × 467–470 µm wide, and the posterior testis measured 617–620 µm long × 492–495 µm wide. A tubular cirrus pouch (157–160 µm long × 149–150 µm wide) lay anterior to the anterior testis, accompanied by a tubular seminal vesicle descending toward the testis. The ovary, spherical (283–285 µm long × 278–280 µm wide), was intertesticular. Adjacent to the ovary's posterior margin lay a small oval seminal receptacle. The filled eggs long tubular uterus starts from the ovary to form a convoluted loop ascending toward the pharynx before descending to a genital pore near the anterior testis. Follicular vitellaria extended bilaterally from the ventral sucker level to the anterior margin of the anterior testis. Two bifurcated excretory ducts extended from the posterior part of the oral sucker and opened into a tubular excretory vesicle, which occupied the space between the posterior cecal ends, with its pore opening sub terminally. The eggs (Fig. 1, D) are light brown, ovoid structures with a smooth shell, measuring 21-24 µm long × 14-17 µm wide. One side appeared slightly flattened, featuring an operculum at one end and a smooth or thickened opposite end.

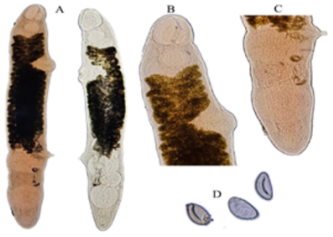

Fig. 1: Light micrographs of adult *Brachylaima* sp. collected from rectum of wild pigeons (*C. livia*) in Al Ain City, UAE. A, whole mount (stained left and unstained right; 80×); B, anterior body (200×); C, posterior body (200×); D, eggs (1200×)

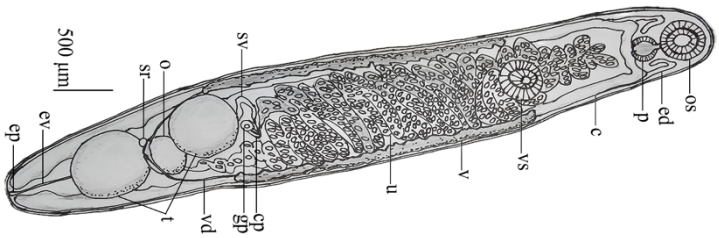

Fig. 2: Ventral view of adult *Brachylaima* sp. collected from rectums of wild pigeons (*C. livia*) in Al Ain City, UAE. Illustration was prepared using a camera lucida. Scale bar: 500 µm. Abbreviations: c, cecum; cp, cirrus pouch; ed., excretory duct; ep, excretory pore; ev, excretory vesicle; gp, genital pore; o, ovary; os, oral sucker; p, pharynx; sr, seminal receptacle; sv, seminal vesicle; t, testis; u, uterus; v, vitellarium; vd, vitelline duct; vs, ventral sucker

Table 1: Comparative morphometrics of adult *Brachylaima* sp. rectal specimens from wild pigeons (*C. livia*) in Al Ain City, UAE, and globally distributed congeners

Checkpoints	*Brachylaima* sp.	*B. syrmatici*	*B. lignieuhadrae*	*B. cribbi*	*B. phaedusae*
Body	4.8 × 0.9 mm	4.5 × 0.6 mm	4.5 × 0.8 mm	5.0×0.68 mm	2.8 × 0.6 mm
Oral sucker	311 × 268 µm	0.4 mm diameter	263 × 278 µm	259 × 279 µm	233 × 247 µm
Ventral sucker	317 × 286 µm	Smaller than oral sucker	305 × 300 µm	277 × 267 µm	231 × 234 µm
Position of ventral sucker	Anterior quarter of body	Middle of body	Anterior quarter of body	Anterior quarter of body	Anterior one-third of body
Pharynx	225 × 201 µm	240 × 275 µm	151 × 194 µm	157 × 169 µm	132 × 181 µm
Anterior testis	527 × 468 µm	160 × 175 µm	443 × 411 µm	419 × 353 µm	294 × 255 µm
Posterior testis	618 × 493 µm	160 × 175 µm	419 × 393 µm	417 × 353 µm	318 × 306 µm
Shape of testes	Oval	Oval	Weakly lobed	Oval	Lobed
Ovary	284 × 279 µm	220 × 200 µm	212 × 276 µm	217 × 261 µm	156 × 201 µm
Shape of ovary	Oval	Oval	Oval	Oval	Oval
Cirrus pouch	158 × 149 µm	180 × 170 µm	278 × 102 µm	Unknown	209 × 72 µm
Seminal receptacle	Present	Not described	Present	Present	Present
Vitellarium	From ventral sucker to anterior testis	Overpassing ventral sucker; anterior end of uterus to anterior testis	From ventral sucker to anterior testis	From posterior to margin of ventral sucker to anterior testis	Overpassing ventral sucker; anterior end of uterus to anterior testis
Defnitive hos	Bird (*C. livia*)	Bird (*Syrmaticus soemmerringii*)	Unknown	Humans, mice (*Mus musculus*), birds (*C. livia*)	Unknown
First intermediate host	Unknown	Unknown	Camaenidae (*Euhadra*)	*Theba pisana*, *Cernuella* spp., *Helix aspersa*	Clausilidae and Camaenidae (*Aegista*)
Second intermediate host	Unknown	Unknown	Camaenidae (*Euhadra, Aegista* and *Ezohelix*)	*Cernuella* spp. *Helix aspersa*	Clausilidae, Camaenidae (*Aegista*) and Pupinidae
References	(This study)	(24)	(4)	(25)	(5)

Discussion

The genus *Brachylaima* Dujardin, 1843 (Digenea: Brachylaimidae) encompasses numerous species, yet its taxonomy remains complex due to insufficient morphological descriptions and incomplete life cycle data for many members (25). Resolving species boundaries within this group requires integrating morphometric analyses of developmental stages with biogeographic insights. The *Brachylaima* sp. investigated in this study shares anatomical similarities with several globally documented species, including *B. syrmatici* and *B. lignieuhadrae* in Japan (4, 24) and *B. cribbi* in Australia (25), particularly in ovarian and testicular positioning and sucker arrangement. However, the specimens analyzed here exhibited distinct body dimensions: they were significantly larger than *B. ishigakiense* (10) and *B. phaedusae* (5), yet smaller than *B. ezohelicis* (26). This finding aligns with broader trends in the genus, where avian-infecting species typically surpass mammalian-infecting counterparts in size.

Key morphological features further distinguish the specimens studied. The oral and ventral suckers were spherical and approximately equal in size, a feature shared with *B. cribbi* (25) and *B. asakawai* (27), distinct from *B. ishigakiense* (10) and *B. simoni* (28), which display disproportionately sized suckers. A short prepharynx preceded the muscular pharynx, which coincides with that of *B. lignieuhadrae* (4) and no esophagus was observed. The digestive ceca were tubular, bifurcating postpharyngeally and extending laterally to the posterior terminus, resembling those of *B. cribbi* (25) and *B. lignieuhadrae* (4). Testes were situated in the posterior body quadrant between ceca, as those of *B. cribbi* (25) and *B. phaedusae* (5). A tubular cirrus pouch is located anterior to the anterior testis, accompanied by a tubular seminal vesicle descending toward the testis. The spherical ovary, situated between the testes, was markedly smaller than the testes, a feature also observed in species such as *B. cribbi* (25) and *B. mascomai* (29). A small, oval seminal receptacle, consistent with structures seen across the genus, lay adjacent to the posterior margin of the ovary. The elongated tubular uterus formed a coiled loop that ascended toward the pharynx before turning downward to connect to a genital pore adjacent to the anterior testis. This morphology aligns with observations in *B. cribbi* (25) and *B. phaedusae* (5), but differs from *B. chiapense* (30), in which the uterus extends upward to the posterior area of the ventral sucker before descending toward the anterior testis. The vitelline follicles extended to the ventral sucker level, a feature aligning with *B. aspersae* (6) and *B. lignieuhadrae* (4). However, that contrasts with *B. phaedusae* (5), where the follicles extend close to the pharynx. Two bifurcated excretory ducts open into a tubular excretory vesicle, which occupies the space between the posterior cecal ends, with its pore opening subterminally, a morphological characteristic of most *Brachylaima* species. Eggs recovered from gravid adults exhibited typical brachylaimid egg morphology, with dimensions overlapping those of such species as *B. cribbi* (25) and *B. mascomai* (29).

Ecologically, *Brachylaima* sp. in this study exhibited site-specific parasitism, colonizing the rectal region of *C. livia* pigeons—a pattern reflecting the genus's adaptive preferences for intestinal niches. The intermediate snail host remains unidentified, a critical knowledge gap given the UAE's arid climate, which typically restricts terrestrial snail habitats. However, localized irrigation in the Al Ain area sustains moist microenvironments in farmlands and palm plantations, likely enabling snail populations to persist and support the trematode's life cycle. Targeted surveys in these areas could identify the intermediate host, clarifying transmission dynamics in arid zones.

Conclusion

This study marks the first documented case of the trematode *Brachylaima* sp. parasitizing wild pigeons in the UAE. Given its potential medical significance, comprehensive molecular and experimental investigations are critical to clarify the taxonomy, life cycle, and host-parasite dynamics within the UAE's unique arid ecosystem.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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