FAMILY BELONDIRIDAE THORNE, 1939

Diagnosis: Lip region narrow, continuous or set off from body contour. Odontostyle small, linear or fusiform, with narrow or wide aperture. Odontophore rod-like or flanged. Anterior narrow and posterior expanded part of pharynx continuous or separated by distinct isthmus-like constriction. Basal expanded part of pharynx greatly variable in size and musculature. Cardia short, conoid to elongate, isthmus-like. Female reproductive system monodelphic or amphidelphic. Vulva transverse or longitudinal. Spicules variable in size and shape. Ventromedian supplements few to numerous. Tail short, bluntly rounded to long, filiform; similar or dissimilar in sexes.

Type subfamily: Belondirinae Thorne, 1939

Other subfamilies:

Dorylaimellinae Jairajpuri, 1964
Swangeriinae Jairajpuri, 1964

Key to the subfamilies of Belondirinae

1. Cuticularised pieces present around oral aperture; Odontophore flanged
   ........................................................................................................ Dorylaimellinae

   Cuticularised pieces not present around oral aperture; Odontophore rod like
   .................................................................................................................. 2.

2. Female tail short, digitate, conoid or rounded
   ........................................................................................................ Belondirinae

   Female tail long, filiform
   ........................................................................................................ Swangeriinae
Genus *Belondira* Thorne, 1939


During present work samples collected from Costa Rica yielded several specimens representing the genus *Belondira*, which on detailed study were found to represent two known and a new species, that are being described in the following.

**Diagnosis:** Belondirinae. Body 0.7 - 2.0 mm long, almost straight to slightly ventrally curved. Lip region rounded, papillae not raised. Outer part of cephalic framework weakly to moderately sclerotized. Amphidial aperture usually as wide as lip region. Odontostyle narrow, usually less than width of lip region. Guiding ring obscure. Odontophore rod-like. Anterior slender part of pharynx expanding below ellipsoidal swelling, then gradually narrowing until it forms basal expanded part; latter encircled by thick sheath of spiral muscle bands. Cardia conoid or rounded. Female reproductive system monophistodelphic. Anterior uterine branch vestigial, saccate. Males with well developed spicules; lateral guiding pieces and one or two widely spaced ventromedian supplements. Tail rounded to clavate, usually with thick cuticle; similar in sexes.

**Type species:** *Belondira apitica* Thorne, 1939
Other species:

*B. affinis* Ahmad, Dhanachand & Jairajpuri, 1982
*B. aquatica* Ferris, Ferris & Goseco, 1983
*B. beluri* Dhanam & Jairajpuri, 1998
*B. brevibulba* Ferris, Ferris & Goseco, 1983
*B. bulbosa* Siddiqi, 1966
*B. caudata* Thorne, 1939
*B. clava* Thorne, 1939
*B. clavicaudata* (Williams, 1958), Andrássy, 1963
*B. cylindrica* Thorne, 1964
*B. eugeniae* Patil & Khan, 1982
*B. goldeni* Suryawanshi, 1972
*B. gracilis* Razzhivin & Milyan, 1978
*B. loofi* Ferris, Ferris & Goseco, 1983
*B. mernyi* Andrássy, 1970
*B. mesoamericana* Ferris, Ferris & Goseco, 1983
*B. microdora* Ahmad, Dhanachand & Jairajpuri, 1982
*B. moldavica* Nesterov, 1976
*B. murtazai* Siddiqi, 1968
*B. neortha* Siddiqi, 1964
*B. nepalensis* Siddiqi, 1964
*B. notabilis* Patil & Khan, 1983
*B. ortha* Thorne, 1939
*B. ovata* Dhanam & Jairajpuri, 1998
*B. paraclava* Jairajpuri, 1964
*B. paratunicaudata* Dhanam & Jairajpuri, 1998
*B. parva* Thorne, 1964
*B. porta* Thorne, 1964
*B. pugwiensis* Choi & Khan, 1999
*B. rafiqi* Suryawanshi, 1972
*B. sacca* Thorne, 1964
B. sacchari Suryawanshi, 1972
B. silvicola Ferris, Ferris & Goseco, 1983
B. syedi Suryawanshi, 1972
B. tarjani Ferris, Ferris & Goseco, 1983
B. ujjanica Siddiqi, 1966
B. tenuidens Thorne, 1964
B. tumicauda Coomans & Baqri, 1972
B. tropica sp. n.

Belondira apitica Thorne, 1939
(Fig. 27)

Measurements: See table 26

Description

Female: Body straight to slightly curved ventrad upon fixation, large sized nematodes. Cuticle finely striated 1-2 μm thick at mid body and 5-6 μm thick on tail. Lateral chords about one-fourth of body width at mid body. Lateral, dorsal and ventral body pores indistinct.

Lip region narrow, continuous, one-fourth body width at neck base; labial sclerotization present. Amphids large, cup-shaped, one half of corresponding body width. Odontostyle small, dorylaimoid, 1.11-1.25 times lip region widths long, its aperture 0.6 times its length. Guiding ring single, at 0.7-0.8 lip region width from anterior end. Odontophore simple, rod-like, 1.4-1.6 times odontostyle length. Nerve ring at about 28-32% of neck length from anterior end. Expanded part of pharynx occupying 52 - 54% of neck length, surrounded by spiral sheath of muscles. Cardia short, bluntly conoid, about one-third corresponding body width. Pharyngeal gland nuclei and their orifices are located as follows:
DO = 50 - 51    $S_1N_1 = 70 - 72$    $S_2N = 86 - 87$
DN = 52 - 53    $S_1N_2 = 74 - 75$    $S_2O = 88 - 89$
DO-DN = 2.5 - 3.0

Reproductive system mono-ophistodelphic with a non functional pre-uterine sac. Ovaries reflexed, 176 - 524 \( \mu \)m long with oocytes arranged in a single row, except near tip. Oviduct joining the ovary subterminally. Uterus a wide tube, measuring 147 - 240 \( \mu \)m; sphincter present at oviduct-uterus junction. Vulva a transverse slit; vagina extending inwards, 34 - 44% of the corresponding body width. *Pars proximalis vaginae* 11 - 13 \( \mu \)m long, 15 - 16 \( \mu \)m wide; *pars refringens vaginae* not sclerotized; *pars distalis vaginae* measuring 2.5 - 3.0 \( \mu \)m. Prerectum 2.4 - 3.8 times anal body widths long. Rectum 1.1 - 1.3 anal body widths long. Tail short, obtusely rounded, 0.58 - 0.87 anal body widths long; hyaline region occupying 25 - 35% of tail length.

**Male:** Not found

**Remarks:**

Thorne (1939) described *Belondira apitica* as the type species of the genus from an elevation of 2896 m on Mt. Wolverine near Brighton, Utah, USA. During course of present study several females were recorded from a soil sample from Costa Rica. Measurements of these specimens completely fit the description and measurements provided by Thorne, 1939 except for longer odontostyle (*vs. odontostyle 7 - 9 \( \mu \)m) and shorter prerectum (*vs. prerectum 2.4 - 3.8 anal body widths*). In addition to the type locality, the species is widely distributed in forest in Indiana and Kansas, USA.
Habitat and locality:

Litter sample, forest plantation; Barbilla National Park, La Amistad Caribe Conservation Area, Costa Rica.

*Belondira cylindrica* Thorne, 1964
(Fig. 28)

Measurements: See table 27

Description

Female: Body straight to slightly curved ventrad upon fixation. Cuticle finely striated, 1.0 - 1.5 μm thick at mid body and 5 - 6 μm thick on tail. Lateral chords about one-third body width at mid body. Lateral, dorsal and ventral body pores indistinct.

Lip region continuous, about one-fifth to one-fourth as wide as body width at neck base. Amphids cup-shaped, their aperture about two-third of the corresponding body width wide. Odontostyle dorylaimoid, 0.71 - 0.85 times lip region width long, its aperture about one-half its length. Guiding ring single, at 0.57 - 0.85 times lip region width from anterior end. Odontophore simple, rod-like, 1.9 - 2.2 times odontostyle length. Nerve ring at 30 - 31% of neck length from anterior end. Expanded part of pharynx occupying about 53 - 61% total neck length, surrounded by spiral muscle sheath. Cardia short, about one-third corresponding body width. Pharyngeal gland nuclei and their orifices are located as follows:

\[
\begin{align*}
DO &= 48 - 50 \\
DN &= 50 - 51 \\
DO - DN &= 1 - 2 \\
S_1N_1 &= 76 - 77 \\
S_1N_2 &= 82 - 83 \\
S_2N &= 92 - 93 \\
S_2O &= 96 - 97
\end{align*}
\]
Reproductive system mono-opisthodelphic; pre-uterine sac present, measuring about 19 - 20 μm; posterior branch well developed. Ovary measuring 156-220 μm, reflexed; oocytes arranged in a single row except near its tip. Oviduct joining the ovary subterminally. Uterus a wide tube, measuring 47-63 μm. Vulva pore-like; vagina extending inwards about half of the corresponding body width, with no sclerotization. 

\textit{Pars proximalis vaginae} 11 x 10 μm; \textit{pars distalis vaginae} measuring 2.5-3.0 μm. 

Prerectum 5.2-5.4 times anal body widths long. Rectum 1.1-1.2 times anal body widths long. Tail 0.66 - 0.88 anal body widths long, obtusely rounded; hyaline part occupying 35 - 42% of total tail length. 

\textbf{Male:} Not found.

\textbf{Remarks:}

\textit{Belondira cylindrica} was originally described by Thorne (1964) from Puerto Rico. Ferris et al. (1983) recorded this species from Panama, Brazil and Colombia. The present specimens from Costa Rica closely fit the earlier descriptions except for having slightly anterior vulva (vs. \textit{V}=38-41) and longer prerectum (\textit{vs.} prerectum 3.5-4.6 anal body widths). The males have not yet been recorded in this species, and the absence of spermatozoa in the uteri of present females also confirm the absence of males in this species. This species seems to be widely distributed in South and Central America.

\textbf{Habitat and locality:}

Litter from forest plantation, La Amistad Caribe Conservation Area, Barbilla National Park, Costa Rica.
Belondira tropica sp. n.
(Fig.28)

Measurements: See table 28

Description

Female: Body almost straight when fixed. Cuticle finely striated, 1.0 - 1.5 μm thick at mid body and 4-5 μm on tail, striations more prominent in tail region. Lateral chords occupying about one-third of the corresponding body width at mid body. Lateral, dorsal and ventral body pores indistinct.

Lip region elevated, continuous, about one-fourth as wide as body width at neck base; labial sclerotization absent. Amphids cup-shaped, their aperture about two-thirds of the corresponding body width wide. Odontostyle very small, 0.8 - 1.0 times lip region width, its aperture about one-third its length. Guiding ring single, about one lip region width from anterior end. Odontophore simple, rod-like, about twice the length of odontostyle. Nerve ring at 35-38 % of neck length from anterior end. Pharyngeal gland nuclei and their orifices are located as follows:

\[
\begin{align*}
DO = 63 - 64 & & S_1N_1 = 75 - 77 & & S_2N = 85 - 86 \\
DN = 64 - 65 & & S_1N_2 = 80 - 81 & & S_2O = 88 - 89 \\
DO - DN = 1.5
\end{align*}
\]

Reproductive system mono-opisthodelphic; anterior uterine branch represented by a sac measuring 16 - 25 μm. Posterior branch well developed; ovary reflexed, measuring 70-207 μm with oocytes arranged in a single row, except near tip. Oviduct measuring 42-95 μm, joins ovary subterminally. Uterus measuring 36-109 μm; sphincter present at oviduct-uterus junction. Vulva situated in a depression, large pore-like. Vagina extending
inward, about half of the corresponding body width; vaginal sclerotization absent. *Pars proximalis vaginae* measuring 9 - 10 x 8 - 9 \( \mu m \); *pars distalis vaginae* 2.5 - 3.0 \( \mu m \) long with curved walls. Prerectum 3.6 - 4.1 anal body widths long. Rectum 1.1 - 1.5 anal body widths long. Tail short, slightly clavate, 1.1 - 1.3 times anal body widths long, hyaline part occupying 42 - 44 % of total tail length giving a fin-like appearance.

**Male:** Not found.

**Diagnosis and relationship:**

*Belondira tropica* sp. n. is characterized by having 0.81-0.95 mm long body; unsclerotized labial region; pharynx expanding behind middle; short anterior uterine branch and clavate tail with distinct radial striae.

The new species closely resembles *B. sacca* Thorne, 1964 but differs in the absence of labial sclerotization (*vs.* labial sclerotization distinct); in having robust odontostyle with distinct aperture (*vs.* odontostyle thin, attenuated); anterior vulva (*vs.* \( V = 36 - 41 \)); shorter tail (*vs.* \( c' = 1.5-2.0 \)) and in the absence of post-rectal sac (*vs.* post-rectal sac present). It also resembles *B. murtazai* Siddiqi, 1968 but differs in having slightly longer odontostyle (*vs.* odontostyle 4 \( \mu m \)); in having lower c value (*vs.* \( c = 46-53 \)); and in having clavate tail (*vs.* hemispheroid tail).

*B. tropica* sp. n. shows close resemblance with *B. nepalensis* Siddiqi, 1964 but differs in having shorter pharyngeal bulb (*vs.* pharyngeal bulb 51% of neck length); lower c value (*vs.* \( c = 53.4 \)); smaller prerectum (*vs.* prerectum five anal body widths long). *B. tropica* sp. n. has characteristic clavate fin-like tail with distinct radial striae whereas in *B. nepalensis* the tail is elongate hemispheroid. Further, *B. nepalensis* is a bisexual
species whereas the *B. tropica* is a monosexual species (sperms were not present in the uteri of any of the females studied).

**Type habitat and locality:**

Soil around roots of forest trees from INBIOPARQUE, Heredia, Costa Rica.

**Type specimens:**

Holotype female on slide *Belondira indica* sp. n. / 1; paratype females on slides *B. indica* sp. n. / 2-5; deposited in the nematode collection of the Department of Zoology, Aligarh Muslim University, India.
Genus *Amphibelondira* Rahman, Jairajpuri, Ahmad & Ahmad, 1987

Rahman *et al.* (1987) proposed the genus *Amphibelondira* with the type and only species *A. bhutanensis* from Bhutan, closely related to *Belondira* but with an amphidelphic gonad.

The present population from Costa Rica was found to represent second species of the genus and is described in the following.

**Diagnosis:** Belondirinae. Medium sized nematode. Lip region narrow, offset by slight depression; lips amalgamated. Labial frame work weakly sclerotised. Odontostyle straight, aperture about one-fourth its length. Odontophore rod-like. Guiding ring single. Pharynx consisting of anterior slender and posterior expanded parts; expansion gradual. Expanded part enclosed in sheath of sinistrally spiral muscle bands. Cardiac spathulate. Female reproductive system amphidelphic; genital branches equally developed. Spicules slender, arcuate; lateral guiding pieces present. Supplements only an adanal pair; ventromedians absent. Tail short, rounded; similar in sexes.

**Type species:** *Amphibelondira bhutanensis* Rahman *et al.*, 1987

**Other species**

*Amphibelondira bongersi* sp. n.
Amphibelondira bongersi sp. n.
(Fig. 30)

Measurements: See table 29

Description

Female: Body slightly curved ventrad upon fixation. Cuticle finely striated, 1.5-2.0 μm thick at mid body and 4.5 μm on tail. Inner layer of cuticle distinctly striated. Lateral chords about one-third body width at mid body. Lateral, dorsal and ventral body pores indistinct.

Lip region offset, slightly narrower than adjoining body, as wide as high and about one-third as wide as body width at neck base; labial frame work well developed. Amphids with large cup-shaped fovea, their aperture about 0.65-0.70 times the corresponding body width. Odontostyle 1.3-1.4 times lip region widths long, its aperture about 1/5<sup>th</sup> – 1/4<sup>th</sup> of its length. Guiding single, at 0.5-0.6 times lip region width from anterior end. Odontophore simple, rod like, 1.8-1.9 times odontostyle length. Nerve ring at 41-46% of neck length from anterior end. Pharynx expanding gradually; expanded part enclosed in a sinistrally spiral muscular sheath, occupying 33-44% of total neck length. Cardia elongate, conoid, 37-55% of corresponding body width long. Pharyngeal gland nuclei and their orifices are located as follows:

\[
\begin{align*}
DO &= 68 - 70 \\
S_1N_1 &= 82 - 83 \\
S_2N &= 90 - 91 \\
DN &= 70 - 71 \\
S_1N_2 &= 84 - 85 \\
S_2O &= 91 - 92 \\
DO - DN &= 2
\end{align*}
\]

Reproductive system amphidelphic; both sexual branches almost equally developed. Ovaries reflexed, measuring 46-64 μm (anterior) and 53-65 μm (posterior) with oocytes
arranged in single row except near tip. Oviduct 49-59 µm (anterior) and 33-63(50) µm (posterior) long. Sperms present in the uterus. A distinct sphincter present at oviduct-uterus junction. Vulva transverse; vagina extending inwards about half of the corresponding body width. Pars proximalis vaginae measuring 14-15 x 11.5-12.5 µm with straight walls supported by strong muscles; pars refringens vaginae absent; pars distalis vaginae 3-4 µm long with curved walls. Prerectum 2.5-3.4 anal body widths long. Rectum 0.8-0.9 anal body widths long. Tail short, obtusely rounded, 0.91-0.95 anal body width long with a hyaline part occupying 20-25 % of total tail length.

Male: Not found.

Diagnosis and relationship:

Amphibelondira bongersi sp. n is characterised by having 1.07-1.12 mm long body; lip region offset with amalgamated lips; vestibule sclerotized; 12.5 µm long odontostyle; amphidelphic gonad and short hemispheroid tail.

The new species differs from the type and only known species of the genus A. bhutanensis Rahman et al., 1987 in having shorter body size (vs. L = 1.38 mm); inner layer of cuticle distinctly striated (vs. finely striated); continuous lip region (vs. slightly offset); shorter odontostyle and odontophore (vs. odontostyle 14 µm and odontophore 16 µm); shape and size of cardia (vs. cardia 17 µm long, a disc like structure present between cardia proper and base of pharynx); posterior vulva (vs. V = 45) and shorter prerectum (vs. 75µm).

The new species further: differs from A. bhutanensis in the presence of a distinct hemizonid at level with nerve ring.
Type habitat and locality:

Mosses growing on tree trunk, gathered close to Fortuna water fall, Primary forest, Arenal National Park, Arenal Conservation Area, Costa Rica.

Type specimens:

Holotype female on slide Amphibelondira bongersi sp. n./1; paratype females on slides Amphibelondira bongersi sp. n./ 2-3; deposited in the nematode collection of the Institut Nacional de Biodiversidad, Costa Rica. A paratype female deposited with the nematode collection of the Department of Zoology, Aligarh Muslim University, India.

Etymology:

The species is named after Dr. Tom Bongers in recognition of his contributions to the Nematode Biodiversity Project, Costa Rica.