

ON SYSTEMATICS OF THE NEMATODE FAMILY LONGIDORIDAE THORNE, 1935
(NEMATODA : DORYLAIMOIDEA)

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Thorne (1935) subdivided the family Dorylaimidae and defined the subfamily Longidoridae in which the genera *Xiphinema*, *Longidorus* and *Longidorella* were placed. In 1937, he suggested that the first two genera should belong to a different family. Later, Meyl (1961) placed all three genera, together with *Xiphinemella*, in the family Longidoridae. At present the family includes three genera: *Xiphinema* Cobb, 1913; *Longidorus* Micoletzky, 1922, and *Paralongidorus* Siddiqi, Hooper & Khan, 1963.

The representatives of these families clearly differ from each other by their basic characteristics: the structure of the stylet, the position of its guiding apparatus, and the size of the amphidial openings. The species *Longidorus siddiqii* Aboul-Eid, 1970 [*Xiphinema brevicaudatum* Schuurmans Stekhoven, 1951 in Siddiqi, 1959] is an exception in the family (besides species inquirendae).

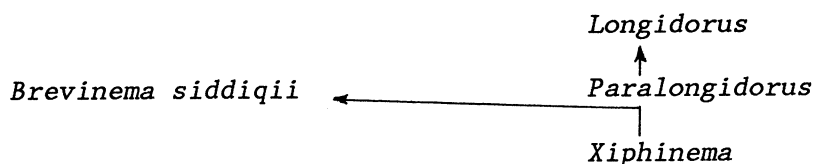
Schuurmans Stekhoven (1951) described *Xiphinema brevicaudatum* a new species found by him in the Belgian Congo, that Thorne (1961) considered to belong in the genus *Longidorus*. As the description by Schuurmans Stekhoven was based on a study of juveniles, Luc and Tarjan (1963) considered it a species inquirenda. Later Siddiqi (1959) found a population of *Xiphinema* identical with *X. brevicaudatum* Schuurmans Stekhoven, 1951 in north India (Uttar Pradesh). He described the population and identified it as *X. brevicaudatum*. According to Aboul-Eid (1970), the specimen used in Schuurmans Stekhoven's description of *X. brevicaudatum* had been lost therefore it was impossible to compare it with the population of Siddiqi (1959). Obviously, *X. brevicaudatum* Schuurmans Stekhoven, 1951, and *X. brevicaudatum* in Siddiqi, 1959, should be regarded as two different species (Aboul-Eid, 1970). *L. siddiqii* (*X. brevicaudatum*) has morphological characteristics of two genera: *Paralongidorus* and *Longidorus*. This species has almost indistinguishable amphidial openings (as in *Longidorus*) and stylet with underdeveloped, non-sclerotized (barely perceptible) thickenings at the base of the odontophore -- a characteristic of *Paralongidorus* --, the interface between odontophore and odontostyle is smooth, with no fissure (as in both genera); the stylet guide ring is just distal to the center of the odontostyle (this likens it to some *Xiphinema* species whose stylet guiding apparatus barely reaches the middle of the odontostyle; indeed in *X. cubense* Razzhivin, O'Reilly & Millan, 1973 it is more distal than in *L. siddiqii*).

The morphological characteristics of the species described by Siddiqi (1959) do not correspond with any of the other three genera in the family Longidoridae although it is included in either the genus *Paralongidorus* or *Longidorus*. The comment 'except *P.* or *L. siddiqii*' therefore should be corrected because, in the first case, of different size of amphidial openings, in the

second, of differences in the base of the stylet, and in both, of different position of the stylet guiding apparatus.

Large populations of this species, first described from India (Siddiqi, 1959) and subsequently found in Israel (Cohn & Martelli, 1961) and Bulgaria (Choleva, 1975) indicate its wide distribution and undoubted viability. Considering that the morphological characteristics of the Indian populations described by Siddiqi are identical with those of the other populations found at different locations, and that these characteristics are stable, we can define the species in question as a separate branch within the family Longidoridae. Thus we propose to define it as a separate genus namely *Brevinema* gen. n..

The family can, therefore, be arranged as in the following scheme:



As regards *Xiphinema sandellum* Heyns, 1966 (species inquirenda) we think that it can be regarded as a population of *L. siddiqii*, as there are only very small differences in the lengths of their tails, stylets (141 vs. 105.0-113.5 μm) and the position of their vulvas (53-54 vs. 49.4-53.5%). The degree of development of the thickening of the stylet and the position of the stylet guiding apparatus are identical in both species.

Presuming that the *Xiphinema* (or the common ancestor of Longidoridae and very similar to them) are the oldest group from which the other genera of the family developed, our proposed scheme is acceptable. Some peculiarities of development, morphology and ecology indeed confirm this presumption.

The representatives of the family Longidoridae are characterized by their slow development, very small number of eggs produced and long adult life. This type of life-cycle requires favorable conditions over a long period. The *Xiphinema* are, in this respect, better adapted than *Longidorus* to the old equatorial, tropical and subtropical forests. The latter are better suited to agricultural conditions of tilling, ploughing, etc. *Xiphinema* thus have a long, strong, rigid odontostyle with well developed thickenings at the base of the odontophore for strong attachment, a proximal stylet guiding apparatus and a wide, muscular, oesophagus. Members of the genus *Longidorus* have no thickenings at the base of the stylet, only one stylet guide ring and the muscular part of the oesophagus is narrower and longer than in *Xiphinema*. Many species in the genus *Longidorus* have adapted to parasitizing annual plants therefore their life-cycles are much shorter.

Xiphinema have broad amphidial openings similar to those in *Paralongidorus*. Amphids in nematodes are present as cuticle folds at or behind the mouth papillae (Croll, 1977). This means that they are not protected from the ingress of soil particles, although during evolution some such protection could have developed. In some species of the family Longidoridae (*Xiphinema insigne*, *X. opistho-*

hysterum, *X. italiae*, *X. vanderlindei*, *Longidorus elongatus*, *L. macromucronatus*, *P. hooperi* etc.) this protection could be afforded by widened mouth parts. The description of the head part of *X. macrostylum* Esser, 1966, is interesting in this context (Esser, 1966): there is an 'amphidial shield': fins on the sides of the head overlapping the amphids. In *Longidorus* the amphids are fully covered by cuticle and their opening is a barely visible slit.

Seventeen out of 72 *Xiphinema* species have a long tail (4-15 times anal body diameter), sometimes whip-like (*X. filicaudatum*, *X. marsupilami*, *X. spinuterus*, etc), which seems to be a rather archaic characteristic. Sixteen of these species occur only in the tropics and subtropics, 13 have been recorded only from the African continent. It must be noted that in species of *Xiphinema* with short, round tails, the tail is always longer, frequently whip-like, in the juvenile stages JI and JII. Adult *Longidorus* and *Paralongidorus* have a short, semi-conical, or more often round tail; in the first two juvenile stages it is longer and pointed.

In contrast with *Paralongidorus* and *Longidorus*, *Xiphinema* have a multitude of morphological characteristics peculiar to each species within the genus. Included are species with body lengths as small as 2 mm whereas others have 5-6 mm body lengths; some have short rounded tails (0.8 anal body diameters), others have long, whip-like tails (10-15 anal body diameters); some with simple reproductive tracts, others with highly specialized uterii (presence of organ and pseudo-organ 'Z', spines), reproductive tracts with reduced anterior tract. Males frequently are rare. In the majority of these species a few males are found for hundreds of females. Obviously, some of these species are at present in the process of evolving while others (Groups: *X. americanum*, *X. diversicaudatum*, *X. index*, *X. coxi*, *X. italiae*, etc.) have reached a high degree of parasitism on old perennials and flourish. It follows that the genus *Xiphinema* is the most conservative of the three genera belonging to Longidoridae as its species have the most primitive, ancient characteristics. Both *Longidorus* and *Paralongidorus* are more or less taxonomically homogeneous genera (as regards sexual systems, shape and length of tail and other morphological characteristics). Representatives of these genera are connected mainly with annual grassland vegetation; this is reflected in the structure of their feeding apparatus.

Several groupings of morphologically similar species exist within the genus *Xiphinema*, whose body length, shape and length of tail and other characteristics are similar. On this basis Cohn and Sher (1972) proposed the division of the family into 8 subgenera: *Radiphinema*, *Krugiphinema*, *Xiphinema*, *Elongiphinema*, *Halliphinema*, *Rotundiphinema*, *Basiphinema* and *Diversiphinema*. However, such a division seems at present to be premature.

Cohn and Sher (1972) subdivided the family into groupings according to one, and then another morphological characteristic, that changed during the evolution of the genera, i.e. according to the structure of the anterior reproductive tract, and length (and shape) of the tail. We propose a somewhat different division, in which together with the principal morphological characteristics of the reproductive system, the length and shape of the tail also is considered. Nematodes with one (posterior) complete reproductive tract are grouped according to the degree of reduction of the anterior reproductive tract:

Group I: *X. flagellicaudatum*: *X. flagellicaudatum*, *X. marsupilami*, *X. spinuterus*.

Group II: *X. hallei*: *X. hallei*, *X. bergeri*, *X. cavenessi*, *X. dimorphicaudatum*, *X. malagasi*, *X. nigeriense*, *X. vanderlindei*, *X. zulu*, *X. douceti*.

Group III: *X. elongatum*: *X. elongatum*, *X. attorodorum*, *X. italiae*, *X. longidoroides*, *X. variabile*, *X. vitis*.

Group IV: *X. americanum*: *X. americanum*, *X. brevicolle*, *X. pachtaicum*, *X. neoamericanum*, *X. opisthohysterum*, *X. rivesi*.

Group V: *X. setariae*: *X. setariae*, *X. bakeri*, *X. basiri*, *X. ifacolum*, *X. meridianum*, *X. sahelense*, *X. vulgare*.

Group VI: *X. diversicaudatum*: *X. diversicaudatum*, *X. basilgoodeyi*, *X. coxi*, *X. ebriense*, *X. imambaksi*, *X. index*, *X. ingens*, *X. mammillatum*, *X. manubriatum*, *X. parvistilus*, *X. paulistanum*, *X. seredouense*, *X. tarjani*, *X. vuittenezi*.

Group VII: *X. rotundatum*: *X. rotundatum*, *X. clavatum*, *X. imitator*, *X. macrostylum*, *X. pini*, *X. pyrenaicum*, *X. tropicale*, *X. turcicum*, *X. yapoense*.

Group VIII: *X. insigne*: *X. insigne*, *X. arcum*, *X. hygrophilum*, *X. orbum*.

Group IX: *X. krugi*: *X. krugi*, *X. costaricense*, *X. filicaudatum*, *X. longicaudatum*, *X. simillimum*, *X. surinamense*.

Group X: *X. radiculicola*: *X. radiculicola*, *X. australiae*, *X. brasiliense*, *X. chambersi*, *X. ensiculiferum*, *X. monohysterum*, *X. orthotenum*.

X. cubense differs from all the other species in the genus by the structure of the female sexual system --its posterior genital branch is reduced.

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