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CONTRIBUTIONS TO THE TAXONOMY STATUS OF *LONGIDORUS LATOCEPHALUS* LAMBERTI, CHOLEVA *ET* AGOSTINELLI, 1983 AND *L. PISI* EDWARD, MISRA *ET* SINGH, 1964 (NEMATODA: LONGIDORIDAE)

by

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Summary. Available information on *Longidorus latocephalus* Lamberti, Choleva *et* Agostinelli, 1983 and *L. pisi* Edward, Misra *et* Singh, 1964 is analyzed taking into consideration the proposed synonymy of both species (Choleva *et al.*, 1991). Minimum and maximum values of ranges of variation or mean values of each character for each population, previously recorded as *L. latocephalus* and *L. pisi*, are plotted. Results show a clear overlapping of populations only for index a, width at guide ring and width at oesophageal junction. All other characters of taxonomic importance distinguished two separate groups of populations (Balkan group as *L. latocephalus* and others as *L. pisi*). Both species are considered to be separate valid species. The population of Petrich previously recorded as *L. siddiqi* (*L. pisi*) (Choleva-Abadzhieva, 1975) is considered to be *L. latocephalus*.

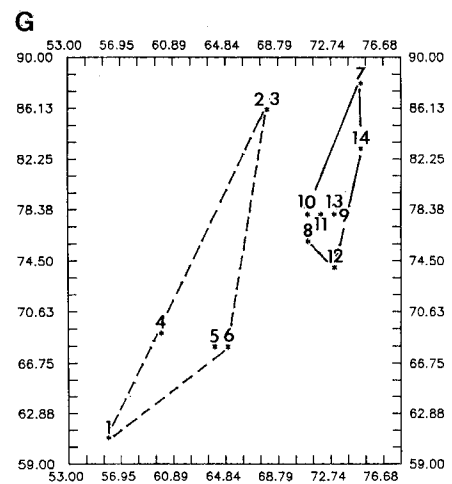
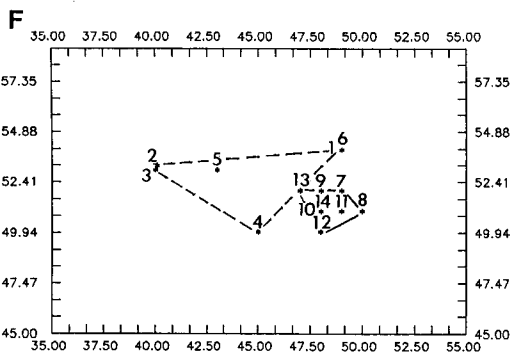
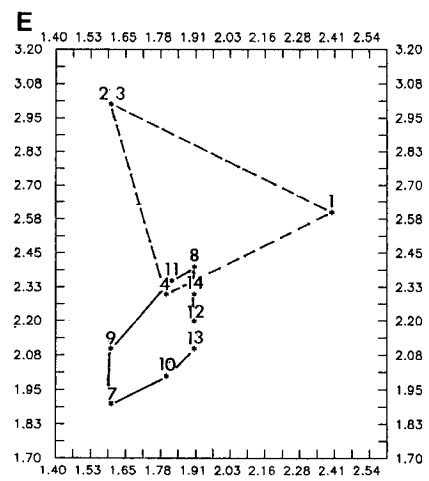
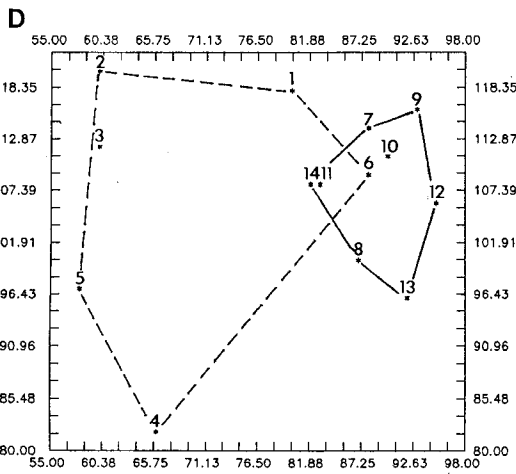
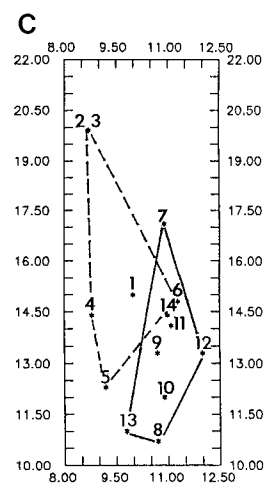
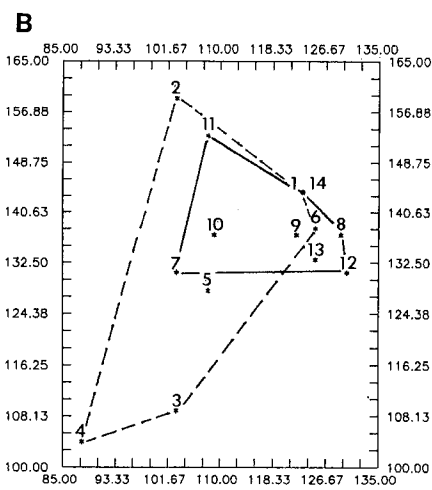
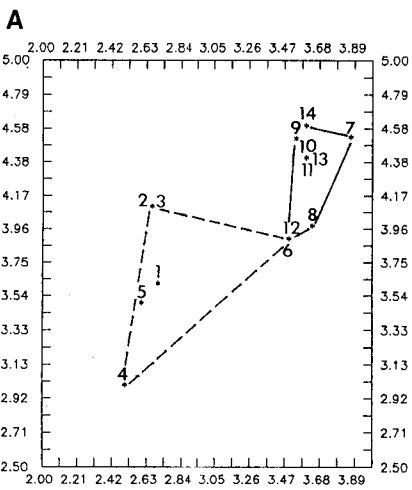
Because the biological species concept is difficult to apply in practical taxonomy of nematode (Heyns, 1983), morphometric characters are needed to define most species. Application of the phylogenetic species concept (Baum, 1992) to classical morphological species with different character states, could result in the same taxonomic unit if the characters are shown not to be homologous. The solution to this problem is to discover new characters and to use parsimony as a tool to detect homology or analogy. However, before this approach can be applied we are forced to re-evaluated classical morphometric characters. Based on classical characters Choleva *et al.* (1991) considered that *L. latocephalus* and *L. pisi* are synonymous. However, reevaluation of the range of variation of these characters for phylogenetic studies (Navas *et al.*, 1993) indicate that *L. latocephalus* and *L. pisi* share different codification when both species are considered in the context of 69 other *Longidorus* species. Using the same data Choleva *et al.* (1991) used, we demonstrate in this paper how *L. latocephalus* and *L. pisi* should be considered as different valid *Longidorus* species.

Materials and methods

Our investigation considered all populations included in Choleva *et al.* (1991) as well as data previously published by Brown *et al.* (1982). These data were based on

one population from Malawi, the original description of *L. pisi* (Edward *et al.*, 1964) and two populations of *L. siddiqi* from India (Siddiqi, 1959; Prabha, 1973). We do not include a population from Cameroons (Chavez and Geraert, 1977) which is based only on one female. We further consider the data attributed to Jacobs and Heyns (1982, 1987), but altered as they appear in Choleva *et al.* (1991).

We propose that it is possible to detect whether there are overlapping character ranges among *Longidorus* populations recorded in the literature as *L. latocephalus* or *L. pisi*. To do this, minimum and maximum values of ranges of variation of each character for each population are plotted. Although the character mean value is used as an important parameter in nematodes taxonomy, its descriptive importance is better understood when there are sufficient numbers of several populations of different species with a similar range of variation. However, as a result of plotting minimum and maximum values, clusters of populations with the same range of variation are detected. Consequently, we are able to use a wider and more accurate auxiliary criterion to detect overlapping species. Numerical values from the literature are used for characters L, a, b, c, c', V, odontostyle length, odontophore length, anterior to guide ring, width anus, tail length, width lip region and width vulva. For graphic display the program PLOT of SURFER 1987 package, has been used.



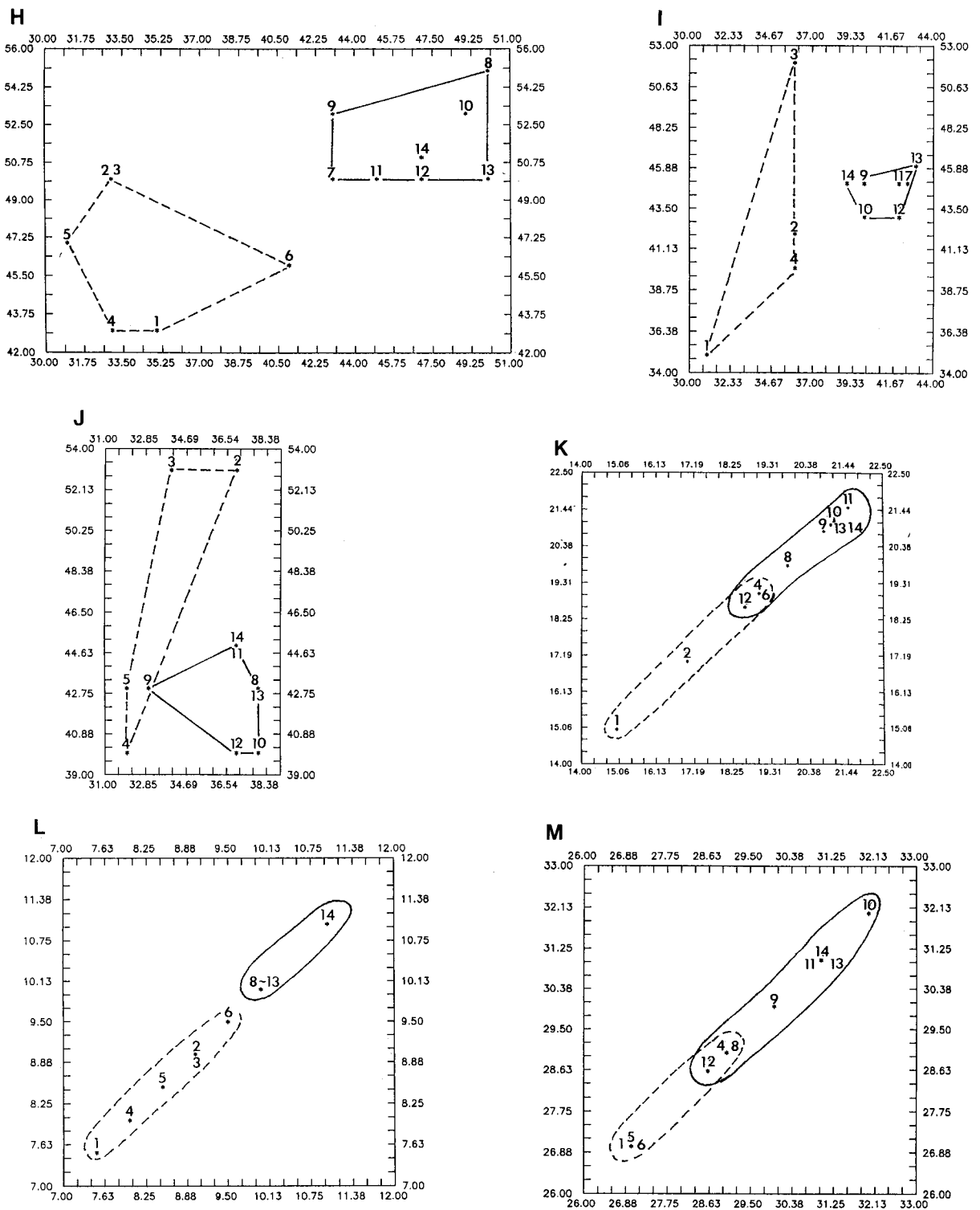


Fig. 1 - Graphic display of morphometric values for the populations of Table I: A, body length; B, index a; C, index b; D, index c; E, index c'; F, index v; G, odontostyle length; H, odontophore length; L, anterior to guide ring; J, tail length; K, anus width; L, lip region width and; M, vulva width. A-J, plot of the minimum (axis x) and maximum (axis y) values of the range of variation for each population; K-M, plot of the available means for each population.

Results and discussion

The main features of populations are summarized from the literature in Table I. All populations except 5 and 6 include a range of variation for characters L, a, b, c, c', V, odontostyle length, odontophore length and anterior to guide ring. Population 5 and 6 have no range of variation for characters c' and anterior to guide ring. Several characters were estimated by Brown *et al.* (1982): character c' and anterior to guide ring (populations 5 and 6), tail length (populations 1 and 6), width at vulva (populations 1, 5 and 6) and width at anus (populations 1 and 6). Since there is

overlapping in the available data for the characters width at guide ring and width at oesophageal junction, they are not included in the graphic display. We omit the character, width at nerve ring, which is only available for the non-Balkan populations. Three characters considered have no variation range for several populations: width at vulva (mid-body) and width at anus (populations 1, 2, 3, 5, 6 and 7) and width at lip region (populations 1, 5, 6, and 7).

Choleva *et al.* (1991) hypothesize that character data of six populations of *L. latocephalus* recorded in six localities of Bulgaria overlap with data (of *L. pisi*) by Brown *et al.* (1982) and especially with the data by Jacobs and Heyns

TABLE I - Features of *Longidorus latocephalus* and *L. pisi* considered.

Population	Origin	Data Reference
1. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	India	Brown <i>et al.</i> (1982) Choleva <i>et al.</i> (1991)
2. <i>L. siddiqi</i> Aboul-Eid, 1970 <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	S. Africa (Natal)	Jacobs and Heyns (1982) Jacobs and Heyns (1987)
3. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	S. Africa (Natal)	Choleva <i>et al.</i> (1991)
4. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	Malawi	Brown <i>et al.</i> (1982)
5. <i>L. siddiqi</i> Aboul-Eid, 1970 <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	India	Prabha (1973) Brown <i>et al.</i> (1982)
6. <i>X. brevicaudatum</i> Schuurmans Stekhoven, 1951 <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	India	Siddiqi (1959) Brown <i>et al.</i> (1982)
7. <i>L. siddiqi</i> Aboul-Eid, 1970 <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	Bulgaria Petrich (V. v.)	Choleva-Abadzhieva (1975) Choleva <i>et al.</i> (1991)
8. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Petrich (A. s)	Choleva <i>et al.</i> (1991)
9. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Petrich (A. s)	Choleva <i>et al.</i> (1991)
10. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Petrich (N. t.)	Choleva <i>et al.</i> (1991)
11. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Parvomai (C. s.)	Choleva <i>et al.</i> (1991)
12. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Parvomai (P. n.)	Choleva <i>et al.</i> (1991)
13. <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Kolatovo (N. t)	Choleva <i>et al.</i> (1991)
14. <i>L. latocephalus</i> Lamberti, Choleva <i>et</i> Agostinelli, 1983 <i>L. pisi</i> Edward, Misra <i>et</i> Singh, 1964	" Petrich (V. v.)	Lamberti <i>et al.</i> (1983) Choleva <i>et al.</i> , (1991)

A. s.: *Actinidia sinensis*, C. s.: *Castanea sativa*, N. t.: *Nicotiana tabacum*, P. n.: *Pinus nigra*, V. v.: *Vitis vinifera*.

(1982). Specimens of *L. pisi* from several countries (Brown *et al.*, 1982), Iraq and the Ivory Coast also were examined and the results of this study are reported here.

Choleva *et al.* (1991) did not comment on the data previously published by Brown *et al.* (1982) nor on previously published data on a population of *L. siddiqi* (= *L. pisi*) from Petrich (Choleva, 1975) (not in 1985, as miscited in table 1 of Choleva *et al.*, 1991). The only reference we found about the synonymy of *L. pisi*-*L. siddiqi* is in the first line of the introduction of Brown *et al.*, 1982 (based in a communication of S. H. Khan to the 3th International Congress of Plant Pathology in Jacobs and Heyns, 1982). Accepting that *L. pisi* is *L. siddiqi*, the morphometry of South Africa population was published as *L. pisi* in 1987. In 1982 this population was still *L. siddiqi*. Choleva *et al.* (1991) do not give the means of the characters for the original description of *L. pisi* nor for the South Africa population. For South Africa population no means are given when the population is considered as *L. siddiqi* (Jacobs and Heyns, 1982), but means are given when it is considered as *L. pisi* (Jacobs and Heyns, 1987). The range of variation of several characters of the South Africa population appears to have been altered in Choleva *et al.* (1991) compared with its source in Jacobs and Heyns (1982 and 1987). Character a: 103-109 (Choleva *et al.*, 1991), 103-159 (Jacobs and Heyns, 1982 and 1987). Character c: 60-112 (Choleva *et al.*, 1991), 60-102 (Jacobs and Heyns, 1982) and 60-120 (Jacobs and Heyns, 1987) (mean of largest values is 111). Anterior to guiding ring: 36-52 (Choleva *et al.*, 1991), 36-42 (Jacobs and Heyns, 1982 and 1987). Tail length: 34-53 (Choleva *et al.*, 1991), 37-53 (Jacobs and Heyns, 1982 and 1987). By deleting the means and accounting for errors in the ranges of variation the populations are similar. There is no statistical analysis.

Fig. 1 presents a graphic display of results. In general the set of Balkan populations (*L. latocephalus*) is more homogeneous than others (*L. pisi*). Even considering the incorrect data for population 3 it is possible to establish clear differences between the two sets of populations. Only for index a is there an overlapping of populations when the range of variation is considered. Even in this case it should be possible to recognize statistically significant differences based on the mean and variance. The estimated mean values of c' and anterior to guide ring for populations 5 and 6, suggest that these populations are within the limit between both species for index c' but in the *L. pisi* group for anterior to guide ring. When values of the means are considered (width anus, width lip region and width vulva) a clear difference between both sets of populations would only have overlapped for the characters width at guide ring and width at oesophageal junction. Although Jacobs and Heyns, (1982 and 1987) extended the range of variation with the Natal population of *L. pisi* for all available characters, this population is excluded from

the cluster of Balkan populations (Fig. 1). The means for each character would be located in the geometric centres of each group of populations. These findings support Lambert's (in Brown and Taylor, 1987) opinion on the value of means to consistently distinguish two separate groups as two valid species. These results also corroborate the diagnostic characteristic of *L. latocephalus* (Lamberti *et al.*, 1983) and allow the Bulgarian population of Petrich (*L. siddiqi* in Choleva-Abadzhieva, 1975) to be considered as *L. latocephalus*. When considering the range of variation of both species in the context of the range of variation of all other *Longidorus* species (69 species) (Fig. 5 of Navas *et al.*, 1993), *L. pisi* has at least one more derived state than *L. latocephalus*. Their coded differences are primarily in L (0 *L. pisi*; 1 *L. latocephalus*), b (1 *L. pisi*; 0 *L. latocephalus*) and V (1 *L. pisi*; 0 *L. latocephalus*). Index a is the same in the original description of both species, but the central points of their range of variation, considering the populations of this study (Fig. 1), are also coded in different groups (Navas *et al.*, 1993; 2 *L. pisi* and 3 *L. latocephalus*). All populations recorded as *L. pisi*, except that from Natal, share a synapomorphy (state 1 of odontostyle) with *L. juvenilis*, *L. laeivicapitatus*, *L. monile*, *L. monilloides*, *L. paramonile* and *L. reneyii*. *L. pisi* seems to be widely distributed through India, the Middle East and Africa (Heyns *et al.*, 1984). This region might hypothetically be the area of distribution of these former group of species, when considering their original descriptions (Williams, 1959; Heyns, 1966; Jacobs and Heyns, 1982 and Raina, 1966) and available data about their distribution (i. e., comments in Brown and Taylor, 1987 on *L. juvenilis* and *L. laeivicapitatus*). Geographic criteria are important general issues in taxonomy and systematics (Hennig, 1966), and should be taken into consideration in the *L. latocephalus*-*L. pisi* controversy. Consequently, we believe that both *L. pisi* and *L. latocephalus* are separate valid species.

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