

Review of Japanese Earthworms (Annelida: Oligochaeta) after Blakemore (2003).

Robert J. Blakemore, COE Soil Ecology Group, Yokohama National University, Japan.

Email: robblakemore@mark.bigpond.com

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Abstract:

This updated revision lists ca. 82 valid earthworm taxa in seven families from Japan with approximately 80 further names (50% of the total) either in synonymy or retained as *species incertae sedis*. About 32 species are known exotics and another ten are possibly more widespread, thus the probable number of wholly endemic Japanese earthworms is around 40 species (ca. 50% of the total valid species). The genera *Lumbricus* and *Polypheretima* are now excluded from Japanese endemism (cf. Easton, 1981), although *Polypheretima elongata* is an introduced taxon.

Changes from (Blakemore, 2003a,b) are new records for exotics *Dendrobaena pygmaea* (Savigny, 1826) from Yokohama, *Eiseniella tetraedra* (Savigny, 1826) from Toyama-ken, *Eukerria saltensis* (Beddard, 1895) from Kamakura/Machida and Biwako, and *Pontoscolex corethrurus* (Müller, 1857) from Okinawa (see Blakemore *et al.*, 2007).

Revised taxa are: *Amyntas agrestis* (Goto & Hatai, 1899), *A. micronarius* (Goto & Hatai, 1898), *A. carnosus* (Goto & Hatai, 1899) (?syn. *A. pingi*), *A. phaselus* (Hatai, 1930), *A. tappensis* (Ohfuchi, 1935), *A. tokioensis* (Beddard, 1892), and *A. koreanus* (Kobayashi, 1934) to include Korean or Japanese names. *Amyntas tokioensis* has *Metaphire levis* as a new synonym, while *M. soulensis* (Kobayashi, 1938) and ?*Metaphire koellikeri* (Michaelsen, 1928) are restored.

Minor modifications are made throughout the text from Blakemore (2003). Additionally, Korean *A. alveolatus* Hong & James, 2001 is syn. nov. of *A. kanrazanus incretus* (Kobayashi, 1937); and *A. yongshilensis* Hong & James, 2001 is comparable to *A. kanrazanus kanrazanus* (Kobayashi, 1937), itself similar to *A. tokioensis*.

Keywords: *M. hilgendorfi*/*A. tokioensis*, *A. corticis* spp-complex, parthenogenetic polymorphism.

Introduction

Taxonomic background

Despite recent revisions (Easton, 1981; Ishizuka, 1999a, 2000c; 2001; Blakemore, 2003), the systematics and taxonomy of Japanese megadriles are chaotic and in urgent need of redefinition. Species names are confounded by homonymy and synonymy due to lack of basic research, non-compliance with the principles of the taxonomic code, the loss or lack of adequate type material, and frequent misidentifications. These difficulties are compounded by problems of language translation and the inaccessibility of obscure publications. Biologically, earthworms in Japan are also characterized by parthenogenetic polymorphism (pers. obs. also *vide intra*) so that many species names have been erected on variously degraded morphs. Reallocation of these names by association with their ancestral and biparental population, where these can be traced via their intermediate forms, may be possible using morphological and molecular techniques. However any answer to a specimen's identity is entirely dependent on the reliability of the original description and its name is determined following the Principle of Priority under the taxonomic code (ICZN, 1999).

The first scientifically named species from Japan were *Megascolex sieboldi*, *Megascolex japonicus*, and *Megascolex schmardae*, all described by Horst (1883) from material in the collections (by P. Fr. B. von Siebold) of the Leiden Museum. Next, Michaelsen (1891) reported *Allolobophora japonica* and *A. fetida* (= *Eisenia*) from Japan, and Rosa (1891) described *Perichaeta ijimae*. In September, 1892, Michaelsen described *Moniligaster japonicus* and *P. hilgendorfi* and in December, 1892 Beddard described *P. rokugo*, *P. nipponica*, *P. masatacae* and *P. tokioensis*. Shortly thereafter Goto & Hatai (1898; 1899) put names to ca. 27 species but their descriptions were inadequate and/or

confused so that most went directly into synonymy or *incertae sedis* in Michaelsen's classical review (Michaelsen, 1900 "Das Tierreich"). Japanese studies continued steadily in a similar fashion to 1941 and were then interrupted for about 40 years until the systematics and distributions of Japanese earthworms were fully revised and reported by Easton (1981). Easton's synopsis described 73 valid species (actually 74 but I exclude the un-named '*Lumbricus* sp. '), with a further 64 pheretimoid names placed in synonymy although 26 of these had question marks next to them. Tsai *et al.* (2000: 288) believed that these latter names should be retained until the specific status of each is verified, thereby possibly raising Easton's total to 99 nominal taxa from Japan; however, I believe that the question mark serves to link possible related species and the "ressurrection" of names should be proven by scholarly research. Ishizuka (1999a, 2000c, 2001) seems to have ignored Easton's revisionary work while erecting approximately 60 new species names (excluding a few that were invalid or *nomina nuda*), several being homonyms, and most of which referred either to previously established taxa or to degraded morphs. Thus, including probable and possible synonymies, nearly 160 species names had been variously reported from Japan to 2002. These names are reviewed here as a prelude to the larger task of full systematic revision with inspection of types, re-survey for new specimens, and comparisons with the faunas in lands adjacent to Japan.

Oriental earthworm faunas tend to be dominated by megascolecoid pheretimoid species, i.e., those formerly attributable to the genus *Pheretima* and characterized by racemose prostates, an oesophageal gizzard (after intersegment 7/8), perichaetine setae, and meric nephridia. Comprehensive reports of pheretimoid taxa have been presented by Michaelsen (1900) who listed all 167 species then known, by Sims & Easton (1972) who reviewed 746 nominal taxa although, according to Sims (1983: 468), about half of

these were synonyms. The revised system of classification of genera presented by Sims & Easton (1972) was further redefined in part by Easton (1979; 1982). More recently, Nakamura (1999b) claimed about 800 species but reversed most established synonymies and nomenclatural advances, and a checklist of 880 valid names was presented by Blakemore (2004). Those Japanese pheretimoids revisited in the paper by Nakamura (1999b, published December 20) were preceded and anteceded with reviews by Ishizuka (1999a, published February 27; 2000c; 2001). Without much justification, both latter authors reverted to some earlier classification of *Pheretima* (cf. this genus' definition in the current work), ignoring taxonomic progress and protocol, whereby several synonymies were inexplicably restored while other unlikely synonymies were invoked and some invalid replacement names were proposed. Such actions are retrograde and could best be ignored except where publication obliges conventional taxonomists to cite these works. However, it may also be argued that some of their nomenclatural acts do not satisfy all requirements for consistent application under the Principle of Binomial Nomenclature of ICZN (1999: Arts. 5.1; 11.4) because Japanese vernacular names are cited simultaneously and these soon assume precedence, e.g. Nakamura (1999b) provides several new Japanese names, and Ishizuka (2001: 50-52, tab. 3-46) entirely dispenses with scientific names in favour of the vernacular. Despite these challenges, a completely orthodox taxonomic revision of Japanese species was attempted by Blakemore (2003a,b).

Pheretimoids are partly distinguished by their caeca (singular, caecum) which are lateral pouches that, when present, occur on the intestine between segments 22 to 28 and possibly function for the maintenance of gut microfloral cultures and/or symbiotic protozoans (see references cited in Blakemore, 2002). In the process of computerized revision of genera into more manageable groups, Sims & Easton (1972) gave some

taxonomic importance to characters of the digestive system, even though it has long been recognized that these may be more adaptive than are the reproductive organs - the “well known dependence of the conformation of the alimentary tract on food and environment” (Stephenson, 1930: 720). Nevertheless, caeca have been accorded taxonomic significance: at the generic level by Sims & Easton (1972), whose redefinition of genera was based partly on the absence or, where present, the segmental origin of the caeca (see Table 1), and at the species level by Ishizuka (1999a). Sims & Easton (1972: Fig. 1, 174, 182-183) recognized three caecal characteristics:

1. Presence of intestinal caeca (absent; present in 22; present in [or near] 27).
2. State of caeca in segment 27 (single, or multiple [= multi-caecate]).
3. Modification of caeca in segment 27 (simple, or complex [= multi-lobed]).

These caecal states condense to three usual forms:

1. Simple, i.e., single with smooth margins.
2. Complex, i.e., single lobed but with several small processes and/or incised margins (= serrate).
3. Multiple, i.e., composed of several digiform diverticula (= manicate or “hand-like”).

Different types of caeca are shown in Fig. 0.1 (below) albeit types 1A-1D may merely be age-related developments, and 1E-1F may be the same too. Interestingly, the genus *Planapheretima* Michaelsen, 1934 allows species with caeca manicate, simple, or absent; and Sims & Easton (1972: 222) allowed for *P. (Parapheretima)* to have either simple or non-simple or multicaecate forms.

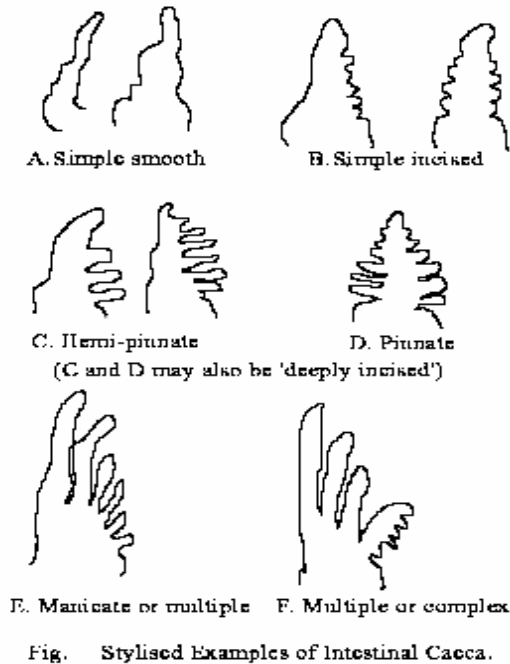


Fig. 0.1 Examples of forms of Intestinal Caeca (original)

Ishizuka (1999a: 56), with a conviction that “*the morphology of intestinal caeca as most important character*”, attempted to differentiate four kinds of caeca (viz. simple, serrate, manicate, and multiple – this latter a supposedly more complex manicate form) while mostly ignoring nephridia, typhlosoles, vascular details, and important taxonomic differences of the male organs. Nakamura (1999b: 4, Fig. 1) only recognized two caecal forms and gave two examples for each but each time mistakenly cited species long established in synonymy and also confused ‘simple and serrate’ with ‘maniccate’, and ‘maniccate’ with Ishizuka’s ‘multiple’ (albeit these latter two are essentially the same).

The difficulty of reliance on caeca is that some early reports do not distinguish between forms, and may even overlook the caeca completely e.g. original descriptions of *Perichaeta iizukai* by Goto & Hatai, 1899 (*vide infra*) and in some synonyms of *Amyntas minimus* (see Sims & Easton, 1972: 224). Moreover, for lobate/serrate caeca,

Sims & Easton (1972: 264) for *P. darnleiensis* (Fletcher, 1887) remarked that these “cannot be regarded as taxonomic characters as they are more fully formed in the larger specimens and their development would appear to be correlated with growth” and for *P. (Parapheretima)* they (Sims & Easton, 1972: 222) allowed simple or multiple caeca. This may also be the case with *Metaphire musica* (Horst, 1882) which was described with either six secondary caeca or only the superior caecum being present (but this is probably misidentification of *Metaphire longa*); with the four former subspecies of *Amyntas jampeanus* (Benham, 1896); with *A. digitatus* (Benham, 1897); with *Metaphire tschiliensis* (Michaelson, 1928); and with *Amyntas tuberculatus* (Gates, 1925) all of which have either simple, albeit incised, or multiple caeca (e.g. as found by Chen, 1936, figs. 18, 21). Chen (1933: 255, figs. 20, 21) in his re-description of *Metaphire yamadai* (Hatai, 1930) had two varieties with either serrate or manicate intestinal caeca (but obviously a misidentification of the former). As further examples: Sims & Easton (1972: 258, fig. 3, tab. 14) describe in detail the various sub-species of *Amyntas omeimontis* (Chen, 1931) that vary in this character (although these may in actuality be separate species according to Blakemore, 2004), and Qiu *et al.* (2002 poster paper at Cardiff conference) say that *Amyntas palmosus* (Chen, 1946) appears to be a species-group with transition from simple to compound caeca. *Amyntas manicatus* (Gates, 1931) from Myanmar and Thailand has perhaps the most developed intestinal caeca: they are manicate or complex in 27 with 4-11 secondary caeca and there are additional rudimentary manicate caeca in some or all of 28-30 (Gates, 1972: 201). Of note is that this latter species, that occasionally has male pores in segment 19 as with *M. megascolidioides*, lacks a typhlosole - a possible analogous structure allowing culture of gut symbionts in the folds as well as increasing the surface area of the gut.

In the Megascolecidae, intestinal caeca are not confined to some pheretimoid genera as species with two pairs have recently been discovered for the first time in Australian natives placed in the genus *Caecadrilus* Blakemore, 2000 and the North American genus *Toutellus* Fender & McKey-Fender, 1990 has several pairs of intestinal caeca in series, and *Promegascolex mekonianus* Cognetti, 1922 also has simple intestinal caeca. In the Octochaetidae, some species of the Indian genus *Eutyphoeus* Michaelsen, 1900 (eg. *E. gigas*) also have intestinal caeca as in the pheretimoids.

Parthenogenetic polymorphism

Current field studies support literature reports of a high frequency of reproductive organ polymorphism in Japanese, Korean, southern Chinese and South-east Asian pheretimoids. Although sexual dimorphism is as yet unknown for hermaphroditic earthworms when compared to the sexually reproducing forms of marine Polychaeta in which the sexes may be separate, or simultaneous, or sequentially hermaphroditic. The three main kinds of morphological variability in earthworms, then, are a result either of different life stages (i.e., cocoon, hatchling, immature, juvenile, sub-adult, adult, regressed adult); or parthenogenetic degradation of reproductive organs; or due to other factors (e.g. aberrations from natural species variability, defective regeneration, and ecotypes - local ecophenotypes or genetic variants caused by geographic, climatic, elevational, or soil related factors). Gates (1972: 16-19) deduced parthenogenesis in lumbricid or megascolecid earthworms where members of a population, rather than aberrant individuals, have some or all of these conditions:

1. Testes and/or seminal vesicles retained in a juvenile state in adult specimens.
2. Absence of spermatozoal iridescence in male funnels and/or spermathecae.

3. Lack of spermatophores or, if present, absence therein of spermatozoa.

[Spermatophores have been found in a few pheretimoids by Michaelsen (1930)].

Male sterility in specimens with any of the above conditions may be further accompanied by loss or degradation, completely or partially, of other sexual structures, e.g. genital markings, spermathecae, male copulatory organs, prostates, and modified setae. Only the clitellum, ovaries, oviducts, and perhaps ovisacs, appear essential for reproduction.

Gates's codes for the common forms of degraded morphs are:

A – for parthenogenetic **athecal** morphs (i.e., lacking spermathecae);

R – for parthenogenetic **anarsenosomphic** morphs (i.e., lacking male terminalia);

Z – for parthenogenetic morphs **lacking testes** (also testis sacs and/or seminal vesicles);

AR - athecal, anarsenosomphic, parthenogenetic morphs;

ARZ – athecal, anarsenosomphic, parthenogenetic morphs without testes;

I – for **intermediate** morphs with incomplete/asymmetrical deletion of the above organs;

Hp – for hermaphroditic parthenogenetic morphs in which the reproductive organs are present but remain in a juvenile state in adult specimens;

H – a **hermaphroditic** morph with biparental reproduction of a species also with parthenogenetic morphs. (Note: the H morph is not to be confused with the Holotype).

Intermediate morphs facilitate recognition of the ancestral amphimictic populations, in which case “the species is understood to include not only the interbreeding population, but also all recently evolved uniparental strains, clones, or morphs that clearly are affiliated with it” (Gates, 1972: 18). Where the original biparental population is unknown, or extinct, the intermediates may at least allow taxonomic synonymy of the variously degraded morphs that have been given species names

precipitously. But this can be problematical when the spermathecae, usually reliable characters for separation of taxa, are variously deleted and degraded. Parthenogenetic morphs may yet copulate (e.g. pseudogamic reproduction with or without exchange of sperm), and polyploidy is not by itself evidential for parthenogenesis as some male sterile diploids are known (Gates, 1972: 16). The functional anatomy of the reproductive organs, especially the spermathecae and prostates, and their importance in earthworm systematics are discussed by Blakemore (2000; 2002).

Japanese studies on variability of genital structures, reproductive processes and breeding habits for parts of the *Metaphire hilgendorfi* / *Amyntas tokioensis* species-complex were by Oishi (1930), Kobayashi (1937), and Ohfuchi (1938a).

Nomenclature and Systematics

The formation of a species' name by taxonomists is governed by rules and recommendations as codified by an international standard, the current version being ICZN (1999 - see <http://www.iczn.org/iczn/index.jsp>), which is also available in Japanese (see <http://www.iczn.org/code.htm>). Classification aims to be universal, hierarchical and phylogenetic. By convention, the species name is tied to and defined by the state of the unique type specimen (i.e., the holotype, lectotype, or neotype). Similarly at its least inclusive definition, the genus is characterized by its named type-species. All specimens that comply with these references, allowing for permissible variation, are attributed to the taxon at each level. Thus, only pheretimoid species with nephridia on the spermathecal ducts and male pores in copulatory pouches, as found in the type-species *Pheretima montana* Kinberg, 1867, belong in the genus *Pheretima* sensu stricto. Homonymy occurs where the same species name is applied to different organisms, although transfer to

separate genera may remove this (ICZN, 1999: Art. 52); synonymy is where the same organism has been given various names, so that only the earliest valid name is correct for that species (Art. 23.3); orthography is the correct spelling of the name (Art. 25) when published (Arts. 7-9, 21-22) by an author (Arts. 50-51). Junior primary homonyms are objectively and permanently invalid under the terms of ICZN (1999: Art. 57.2), but junior secondary homonyms are only treated as invalid whilst considered congeneric (Art. 59) and may be reinstated, with any replacement name proposed after 1960 entering their synonymy (Art. 59.4).

However, the naming process is a human activity that differs from speciation processes at work in Nature. Parthenogenetically degraded morphs that do not reproduce by normal meiosis and cross-fertilization to produce diploid offspring are outside the conventional species concept (e.g. Mayr, 1968; Gates, 1972; Reynolds, 1974). And, even though the availability of a taxonomic name is not affected even if "*it is based on only part of an animal, or one sex, or one stage in the life cycle, or one of several dissimilar generations, or one morph or caste of a polymorphic species, or a parthenogenetic form, or a specimens which is an unusual example of the taxon*" (ICZN, 1999: Art. 17.3), it is preferable that polymorphic forms should be distinguished only after considerable research has been conducted to determine the ancestral populations from whence they originate; moreover, Gates (1972: 95) said that provision of names for all intermediate morphs is "ridiculous". A major problem with Japanese systematics is that degraded morphs lacking male pores and spermathecae cannot easily be classified at genus nor species level by morphological methods alone, although not infrequently these events have been accorded scientific names.

Materials and Methods

The current taxonomic revision attempts, under ICZN (1999), to reallocate morphs that have been given names, or to associate them within informal species-complexes; alternatively they are listed as *species incertae sedis* until such a time as they can be linked with more definite descriptions of complete specimens from biparental populations that are not necessarily from Japan. The basis for this revision is a data survey from the literature complemented with species inspections where specimens were available. Examples of the most common cosmopolitan species obtained from various sources around the world have been previously redescribed (e.g. Blakemore, 1994; 1999; 2000; 2002). Due to operational constraints Japanese type specimens have yet to be thoroughly tracked, but there is no indication that these were inspected by Easton (1981), nor by Ishizuka (1999a; 2001). However, some specimens in institutional collections have been inspected and incidental collection by the author around Tokyo, Kanagawa, Nara and Kanazawa districts of Honshu and Shikoku Islands, Japan in 2001-2003 has allowed some redescription based on fresh material. While reallocating taxa as necessary, the classification system employed herein complies with recent precedent: nomenclature of pheretimoids follows Sims & Easton (1972) and Easton (1979; 1981), while lumbricid nomenclature mostly follows Sims (1983) and Easton (1983) that, surprisingly, are more in line with current concepts than the nomenclature presented by Sims & Gerard (1985) that is repeated in a new but unrevised edition in Sims & Gerard (1999). Brief diagnoses are given for the pheretimoids. Type locations and materials are derived from original descriptions, or from Michaelsen (1900), Gates (1972), and Reynolds & Cook (1976).

Some of the synonyms against which Easton (1981) had placed question marks are supported pending further investigation, but these names are also placed within braces

in the species' synonymies herein. Other braces surround the synonym concepts of previous authors following their citation, and these may or may not be wholly accepted currently. Where these authors expressed reservation, a question-mark precedes the specific name. Colons mark non-original citations (e.g. re- and mis-descriptions) and semi-colons separate repetitions. The synonymy format is therefore similar to that of Sims & Easton (1972: Appendix III). Other descriptive conventions are those usually employed for earthworm systematics (eg. Easton, 1981; Blakemore, 2000; 2002).

Systematics Results –Checklist of Japanese Earthworms

Summary Checklist of Taxa

* = exotic/introduced, - = native/endemic, # = uncertain origins/affinities; syn. = synonyms.
For common exotics not all synonyms are given as these may be readily found elsewhere eg. Blakemore (2002 and in prep.).

Family Moniligastridae

- #1. *Drawida hattamimizu* Hatai, 1930.
- *2. *Drawida japonica* (Michaelsen, 1892) (syn. *grahami*).
- #3. *Drawida keikiensis* Kobayashi, 1938.
- #4. *Drawida koreana* Kobayashi, 1938.
- 5. *Drawida moriokaensis* Ohfuchi, 1938.
- #6. *Drawida nemora* Kobayashi, 1936.
- 7. *Drawida ofunatoensis* Ohfuchi, 1938.
- 8. *Drawida tairaensis* Ohfuchi, 1938.

Family Criodrilidae

- 9. *Biwadrilus bathybates* (Stephenson, 1917) (syn. *miyashitai*).

Family Lumbricidae

Aporrectodea caliginosa species-group sensu Blakemore (2002). Included species reported from Japan:

- *10. *Aporrectodea caliginosa* (Savigny, 1826).
- *11. *Aporrectodea trapezoides* (Dugès, 1828).
- *12. *Aporrectodea tuberculata* (Eisen, 1874).
- *13. *Aporrectodea rosea* (Savigny, 1826).
- *14. *Bimastos parvus* (Eisen, 1874).

#15. *Dendrobaena octaedra* (Savigny, 1826).

*16. *Dendrobaena pygmaea* (Savigny, 1826). **New record Japan.**

Dendrodrilus rubidus species-complex sensu Blakemore (2002). Included subspecies reported from Japan:

*17. *Dendrodrilus rubidus rubidus* (Savigny, 1826).

*18. *Dendrodrilus rubidus tenuis* (Eisen, 1874).

Eisenia fetida species-complex sensu Blakemore (2002). Included species reported from Japan:

*19. *Eisenia andrei* Bouché, 1972.

*20. *Eisenia fetida* (Savigny, 1826).

#21. *Eisenia japonica* (Michaelsen, 1891) (syn. *japonica gigantea*; *japonica minuta*).

*22. *Eiseniella tetraedra* (Savigny, 1826) – new record for Japan.

[Note: a new *Helodrilus* sp. from Hachioji western Tokyo is by Blakemore (in prep.)].

Family Ocnerodrilidae

*23. *Eukerria saltensis* (Beddard, 1895). **New records Japan/Asia.**

*24. *Ocnerodrilus occidentalis* Eisen, 1878.

Family Acanthodrilidae

*25. *Microscolex phosphoreus* (Dugès, 1837).

Family Octochaetidae (Subfamily Benhamiinae)

*26. *Dichogaster (Diplothecodrilus) bolau* (Michaelsen, 1891) (syn. *?hatomaana*).

*27. *Dichogaster (Diplothecodrilus) saliens* (Beddard, 1893) (syn. *?hatomaana*).

Family Megascolecidae sensu Blakemore (2000)

#28. *Pontodrilus litoralis* (Grube, 1855) [syn. *marionis*; *bermudensis*, *matsushimensis*, *albanyensis*, *cygni*, *indica*, *gracilis*; full synonymy in Blakemore (2002)].

*29. *Perionyx excavatus* Perrier, 1872 (syn. *gruenewaldi*; *fulvus*, *?koboensis*, *?turaensis*).

#30. *Amyntas carnosus* (Goto & Hatai, 1899) (syn. *?pingi* Stephenson, 1925; *kyamikia* Kobayashi, 1934; *?youngtai* Hong & James, 2001; *sangyeoli* Hong & James, 2001; *?A. nanshanensis* Shen *et al.*, 2003).

-31. *Amyntas conformis* (Ishizuka, 2000) [syn. *monticola* Ishizuka, 2000 - a permanently invalid primary homonym, non Beddard, 1912 (= *Polypheretima monticola*); an invalid manuscript name "montivaga" was sometimes supplanted over this name].

Amyntas corticis species-complex. Included species from Japan:

#32. *Amyntas corticis* (Kinberg, 1867) [syn. *diffringens*; *?sanctae-helenae*; *subquadrangula*; *indicus* Horst, 1883 [non *Perichaeta indica* : Horst, 1885 (= *Pheretima darnleiensis*)]; *peregrina*; *?mirabilis*; *heterochaeta*; *?ijimae*; *divergens*; *nipponica*; *?molukaiensis*; *heteropoda*; *?marenzelleri*; *divergens yunnanensis*; *?sheni*; *oyamai*; *tajiroensis*; *?homosetus*; *?mori*; *toriii*; *clerica*; *?hatomajimensis*; *medicampestris* Nakamura, 1999 [nom. nov. pro *campestris* Lee, 1952 non Goto & Hatai, 1898 (= *A. robustus*)]; *imajimai*; *confusa*; *nipparensis*; *subrotunda*; *rufidula*; *silvestris* Ishizuka, 1999 [a permanently invalid primary homonym, non Michaelsen, 1923]; *semilunaris*; *fulva*; *subterranea*; *subalpina*; *mutabilis*; *nubicola*; *umbrosa*; *invisa* Ishizuka, 2000 [a permanently invalid primary homonym, non Cognetti, 1913]; *nigella*; *?setosa* Ishizuka *et al.*, 2000 (a permanently invalid primary homonym, non Cognetti, 1908)].

-33. *Amyntas distichus* (Ishizuka, 2000).

-34. *Amyntas ellipticus* (Ishizuka, 1999).

-35. *Amyntas flavescens* (Goto & Hatai, 1898) (syn. *producta*; *houletti* *bidenryoana*; *leucocirca* : Ohfuchi, 1956 [non Chen, 1933]; *noharuzakiensis*).

- 36. *Amyntas fuscatus* (Goto & Hatai, 1898) (syn. *grossa*; *iizukai*; *?shimaensis*; *montana* Ishizuka, 1999 [a permanently invalid primary homonym, non Kinberg, 1867]; *atrorubens*; *alpestris*; *dura*; *turgida*; *argentea*; *?flavida*; *?lactea*; *?mitakensis*).
- #37. *Amyntas glabrus* (Gates, 1932) (syn. *tenellula*; *vieta*; *papilio* : Ohfuchi, 1956 [?misidentification, non Gates, 1930]).
- *38. *Amyntas gracilis* (Kinberg, 1867) [syn. *hawayana*; *bermudensis*; *mandhorensis*; *?mauritiana*; *?kamakurensis*; *?parvula* Goto & Hatai, 1898 non Ohfuchi, 1956 (= *Metaphire parvula*) nec Ishizuka *et al.*, 2000 (= '*P*' *palarva* Blakemore, 2003); *?decimpapillata*; *?kagoshimensis*; *autumnalis*].
- 39. *Amyntas habereri* (Cognetti, 1906).
- *40. *Amyntas hupeiensis* (Michaelson, 1895).
- 41. *Amyntas? japonicus* (Horst, 1883).
- 42. *Amyntas kunigamiensis* (Ishizuka & Azama in Ishizuka, Azama & Sasaki, 2000).
- 43. *Amyntas micronarius* (Goto & Hatai, 1898) (syn. *?yamizoyamensis* ; *obtusa* ; *hinoharensis*; *?hypogaea*; *?edoensis*).
- *44. *Amyntas minimus* (Horst, 1893) (syn. *pusilla* Ude, 1893 [non Ohfuchi, 1956]; *enchytraeoides* ; *zoysiae*; *?fungina*; *?muta*; *ishikawai*; *humilis*).
- *45. *Amyntas morrissi* (Beddard, 1892) (syn. *barbadensis*; *?pallida*; *hawayana lineata* ; *exiloides* : Ohfuchi, 1956 [non Chen, 1936]; *elongata* : Ohfuchi, 1956 [non Perrier, 1872]).
- 46. *Amyntas obscurus* (Goto & Hatai, 1898) [non Spencer, 1893 (= *Diporochoaeta obscura*)].
- *47. *Amyntas papulosus* (Rosa, 1896) (syn. *papulosa sauteri*; *composita*; *rockefelleri*; *hsinpuensis* Kuo, 1985).

#48. *Amyntas phaselus* (Hatai, 1930) [syn. ?*maculosus* Hatai, 1930 [non Gates, 1933 (= *malaca* Gates, 1936) nec *medimaculosa* Nakamura, 1999]; ?*kamitai* (syn. *serrata*), ?*phaselus tamurai*].

-49. *Amyntas quintanus* (Ishizuka, 1999).

*50. *Amyntas robustus* (Perrier, 1872) [syn. *masatacae*; *campestris* Goto & Hatai, 1898 (non Lee, 1952); ?*zavattarii*; *ornata*; ?*sheni*; ?*lauta* (*siemsseni*, *fokiensis*); *corrugata*].

-51. *Amyntas scholasticus* (Goto & Hatai, 1898).

-52. *Amyntas yambaruensis* (Ishizuka & Azama in Ishizuka, Azama & Sasaki, 2000).

-53. *Metaphire acincta* (Goto & Hatai, 1899) (syn. *yezoensis*).

*54. *Metaphire californica* (Kinberg, 1867) (syn. *modesta*; *molesta*; *sakaguchii*; *sonaiensis*).

Metaphire hilgendorfi / *Amyntas tokioensis* species-complex [*Amyntas hilgendorfi* species-complex sensu Easton (1981)]. Included species recorded from Japan:

-55. *Amyntas agrestis* (Goto & Hatai, 1899) (syn. *striata*).

-56. *Amyntas ambiguus* (Cognetti, 1906) [Non *Pheretima barbara ambigua* Cognetti, 1913: 302 from New Guinea (= *Pheretima barbigua* Blakemore, 2004 nom. nov)].

-57. *Amyntas gomejimensis* (Ohfuchi, 1937).

#58. *Amyntas koreanus* (Kobayashi, 1934) (syn. *Pheretima conjugata* Ishizuka, 1999 - synonym as per Blakemore, 2003: 43, addenda).

-59. *Amyntas parvicystis* (Goto & Hatai, 1899) [syn. ?*verticosa*; cf. *tokioensis*].

-60. *Amyntas purpuratus* (Ishizuka, 1999b).

#61. *Amyntas tappensis* (Ohfuchi, 1935) (syn. *bimaculata*, *silvatica*, ?*surcata*,

odaesanensis Hong & James, 2001, *rihii* Hong & James, 2001, *fasciiformis* Hong & James, 2001 - synonym as per Blakemore, 2003: 43, addenda; *sanchongensis* Hong & James, 2001).

#62. *Amyntas tokioensis* (Beddard, 1892) (syns. ?*Perichaeta schizopora* Goto & Hatai, 1898: 76, ?*Perichaeta irregularis* Goto & Hatai, 1899: 13 [non Spencer, 1895 (= *Perionychella irregularis*), cf. *A. hilgendorfi*], *Perichaeta levis* Goto & Hatai, 1899: 20, (?*parvicystis*; ?*verticosa*; ?*Amyntas yongshilensis* Hong & James, 2001: 80), *A. eastoni* Hong & James, 2001: 83; *A. boletiformis* Hong & James, 2001: 84 [these synonyms as per Blakemore (2003: 43, addenda; 2005); ?*Amyntas paiki* Hong in Hong, Lee & Kim, 2001: 266 **Syn. nov.** - <http://zoolstud.sinica.edu.tw/Journals/40.4/263.pdf>).

-63. *Amyntas vittatus* (Goto & Hatai, 1898).

-64. *Amyntas? yunoshimensis* (Hatai, 1930).

-65. *Metaphire communissima* (Goto & Hatai, 1899) (syn. *Perichaeta sieboldi* : Goto & Hatai, 1898: 65 [non *Megascolex sieboldi* Horst, 1883 (= *Metaphire sieboldi*)]; *sieboldi lenzi* ; *florea*).

-66. *Metaphire hataii* (Ohfuchi, 1937: 13). [Provisionally restored from *Metaphire agrestis* (= *Amyntas agrestis*) synonymy].

#67. *Metaphire hilgendorfi* (Michaelsen, 1892) [syn. *rokugo*; ?*irregularis* Goto & Hatai, 1899 [non Spencer, 1895 (= *Perionychella irregularis*)]; ?*yunoshimensis*, *glandularis*].

-68. *Metaphire servina* (Hatai & Ohfuchi, 1937).

#69. *Metaphire soulensis* (Kobayashi, 1938) (syn. *Pheretima shinkeiensis*

Kobayashi, 1938, *Pheretima aokii* Ishizuka, 1999 - synonymy as per Blakemore, 2003: 43, addenda); ?*Amyntas dageletensis* Hong & Kim [2005: 129](#). From Korea. ?Syn. Nov..

#70. *Metaphire vesiculata* (Goto & Hatai, 1899)
(syn. ?*okutamaensis* ; ?*biggiberosa*).

*71. *Metaphire yamadai* (Hatai, 1930) (syn. ?*pectinifera* Michaelsen, 1931 - synonymy as per Blakemore, 2003: 43, addenda).

[End of *M. hilgendorfi* / *A. tokioensis* species-complex].

#72. *Metaphire megascolidioides* (Goto & Hatai, 1899).

-73. *Metaphire parvula* (Ohfuchi, 1956) [non Goto & Hatai, 1898; nec Ishizuka *et al.*, 2000 (= '*P.* *parlarva* nom. nov. Blakemore, 2003)].

*74. *Metaphire peguana* (Rosa, 1890) (syn. *saigonensis*).

-75. *Metaphire riukiuensis* (Ohfuchi, 1957).

*76a. *Metaphire* (now *Duplodidodrilus*) *schmardae schmardae* (Horst, 1883) [non *Megascolex schmardae* Michaelsen, 1897], (syn. *triphyla*; *kikuchii*).

*76b. *Metaphire* (now *Duplodidodrilus*) *schmardae macrochaeta* (Michaelsen, 1899).

-77. *Metaphire sieboldi* (Horst, 1883) [non *Perichaeta sieboldi* : Beddard, 1892b: 759; nec Goto & Hatai, 1898: 65 (= *Metaphire communissima*)], (syn. *setosa* Cognetti, 1908 [non Ishizuka *et al.*, 2000]).

-78. *Metaphire tosaensis* (Ohfuchi, 1938).

#79. ?*Metaphire koellikeri* (Michaelsen, 1928) (?introduction).

*80. *Pithemera bicincta* (Perrier, 1875) (syn. ?*violacea*, ?*aimerikiensis*- synonymy as per Blakemore, 2003: 43, addenda).

Polypheretima elongata species-complex [*Metaphretima elongata* species-complex

sensu Sims & Easton (1972); Easton (1976)]. Included species from Ryuku Islands:

*81. *Polypheretima elongata* (Perrier, 1872) [non *Pheretima elongata* : Ohfuchi, 1956 (= *Amyntas morrisi*)], (syn. *biserialis*, *acystis*, *monocystis*, *aelongata*).

Family Glossoscolecidae

*82. *Pontoscolex corethrurus* (Müller, 1857) (syns. - see Blakemore (2002). **New record from Okinawa, Japan** (although Nakamura (1994) reports it from Ogasawara /Bonin Isls.).

Species incertae sedis [i.e., “of uncertain taxonomic position” ICZN (1999: Glossary)].

Amyntas hibernus (Ishizuka, 1999).

Amyntas illotus (Gates, 1932) species-group sensu Sims & Easton (1972). Included names recorded from Japan:

Amyntas assacceus (Chen, 1938) [syn. *medipusillus* Nakamura, 1999 nom. nov. pro *Pheretima pusilla* Ohfuchi, 1956 (non Ude, 1893); ?*Amyntas proasacceus* (sic) Tsai *et al.*, 2001].

Amyntas illotus : Ohfuchi, 1956: 136 [non Gates, 1932: 397].

Amyntas imperfectus (Ishizuka, 1999).

‘*Pheretima*’ *oyuensis* Ohfuchi, 1937, perhaps as *Amyntas?* *oyuensis*.

[End of *A. illotus* species-group].

Amyntas octo (Ishizuka, 2000).

Amyntas stipatus (Ishizuka, 1999).

Amyntas tamaensis (Ishizuka, 1999).

‘*Pheretima*’ *palarva* Blakemore, 2003 [nom. nov. pro *P. parvula* Ishizuka *et al.*, 2000 non *Perichaeta parvula* Goto & Hatai, 1889 (?= *A. gracilis*), nec *Pheretima parvula* Ohfuchi, 1956 (= *Metaphire parvula*); perhaps better as *Amyntas?* *palarvus*].

(* = exotic/introduced, - = native/endemic, # = uncertain affinities, syn. = synonyms).

Details of Revisions with Taxonomic Diagnoses (Families after Blakemore, 2000)

Family Moniligastridae

Genus *Drawida* Michaelsen, 1900

Remarks: The distribution of *Drawida* was stated by Easton (1981: 34) to include Korea, 'Manchuria' and eastern Siberia as well as most of the Oriental Region, especially India, although he noted that the family Moniligastridae possibly invaded Asia after the collision of the Indian and Asian plates during the Tertiary period. Gates (1972: 238) considered *Drawida* to have a self-acquired range greater than that of the 'Pheretima domain', with the total of species expected to rival the number of pheretimoids. Several species are cosmopolitan and their distribution has been extended by human activities (see Gates, 1972; Easton, 1982; Blakemore, 1999; 2002). Easton (1981) remarked that the genus is poorly known in Japan, and that five new *Drawida* species names listed by Oishi (1932: 18), e.g. "*Drawida hattai*", were not supported by descriptions and are therefore *nomina nuda* outside of nomenclature.

Drawida hattamimizu Hatai, 1930

Drawida hattamimizu Hatai, 1930a: 485. From Hatta & Kanazawa. Types not known.

Distribution: Japan (Hokkaido, Kanazawa, Hatta village and Lake Biwa region).

Remarks: Large species with wide but restricted distribution in Japan that suggests it was possibly imported, although it is not yet known elsewhere. Identification confirmed on new material from type locality collected by current author in 2002.

Drawida japonica (Michaelsen, 1892)

Moniligaster japonicus Michaelsen, 1892: 232. From Japan. (Syn-)types in Hamburg

Museum: 403 (Reynolds & Cook, 1976), but stated by Michaelsen as in Zoological Museum, Berlin: 2122 (and this syntype is also listed by Hartwich & Kilius, 1989: 268 and, now, confirmed by Reynolds & Cook, 1992: 25).

Drawida japonica : Michaelsen, 1900: 115; 1910: 48; Chen, 1936: 291 (syn. *grahami*); Easton, 1981: 37.

Drawida japonica typica: Michaelsen, 1910:49.

Drawida grahami Gates, 1935: 3. From Suifu, Szechuan. Type USNM: 20093.

Distribution: *Drawida japonica* is probably not endemic to Japan as Tsai *et al.* (2000: 290) list and cite references for its distribution in southern China, Taiwan, the Ryukyu Islands, Japan, Korea, and south-east Asia. Also reported from Indian Himalayas (Stephenson, 1917, 1923).

Remarks: Michaelsen (1910: 48-52; 1931b: 7; 1931: 523) established subspecies for this taxon, *Drawida japonica siemsseni* (Michaelsen, 1910) from Fuchow, China, and *Drawida japonica bahamensis* (Beddard, 1893) that was subsequently placed, at least by Easton (1984), in synonymy of *Drawida barwelli* (Beddard, 1886). Kobayashi (1940) had proposed a dispersal of *D. japonica* from China to Japan, possibly via Taiwan and questioned the identification of some earlier records from outside the Japan/Korea area. Nevertheless, Gates (1972: 244) was of the opinion that this species came originally from the Indian Himalayas, where it was first recorded by Stephenson (1917), from Yunnan and Szechuan. Easton (1981: 37) included only Japanese and Korean records in his distribution range for this taxon. Michaelsen (1892) described a pair of markings on 10 in front of male tubercles in 10/11. Easton and Stephenson only say markings are in 7-9, and sometimes 12 and 13; overlookin those stated to be in 10. Identification to be confirmed and augmented from inspection of new material by current author (ms in

preparation).

Drawida keikiensis Kobayashi, 1938

Drawida keikiensis Kobayashi, 1938: 107. Types?

Distribution: Japan and Korea.

Drawida koreana Kobayashi, 1938

Drawida koreana Kobayashi, 1938: 102. Types?

Distribution: Korea and Japan.

Drawida moriokaensis Ohfuchi, 1938

Drawida moriokaensis Ohfuchi, 1938b: 44. Types?

Distribution: Japan.

Drawida nemora Kobayashi, 1936

Drawida nemora Kobayashi, 1936c: 141. Types?

Distribution: Korea and Japan.

Drawida ofunatoensis Ohfuchi, 1938

Drawida ofunatoensis Ohfuchi, 1938c: 33. Types?

Distribution: Japan.

Drawida tairaensis Ohfuchi, 1938

Drawida tairaensis Ohfuchi, 1938b: 39. Types?

Distribution: Japan.

Family Criodrilidae Vejdovsky, 1884

[including Biwadrilidae as the separation, e.g. by Sims (1980: 106), on the basis of lateral lines appears erroneous, pers. obs.].

Biwadrilus bathybates (Stephenson, 1917)

[Fig. 1](#) *Biwadrilus bathybates* (original figure).

Criodrilus bathybates Stephenson, 1917: 96. From Biwa-ko (60m deep). Types are four immatures in Calcutta Museum. [Often misspelt "*bathybathes*"]

Criodrilus miyashitai Nagase & Nomura, 1937: 361. From Komori-machi, Kyoto and Tsuruoka, Yamagata-ken coastal NW Japan. Types unknown.

Biwadrilus bathybates : Easton, 1981: 40 (syn. *miyashitai*).

Distribution: Mainly known from the Lake Biwa region of central Honshu, Japan, also reported from NW coastal Yamagata-ken and SW coast Hyogo-ken.

Remarks: The previous family Biwadrilidae was monotypic although Sims (1980: 115; 1982: 285) seems to suggest that the family may be recombined with Criodrilidae as it differs only in details of its vascular system, in particular the presence of a supra-oesophageal vessel (and possible lack of a sub-neural vessel) and presence of "prostate glands" in 13. The stated presence of "a paired lateral line", eg. by Sims (1980: 106, 115), appears to be mistaken as the only visible lateral lines are due to blood vessels clearly visible through the body wall in the anterior segments in live specimens (pers. obs.).

Family Lumbricidae

Only partial synopses are given here, full synonymies of the species, diagnoses and distributions may be found elsewhere (e.g. Gates, 1972; 1974; Easton, 1983; Sims & Gerard, 1985; 1999; Blakemore, 2002 and a checklist of all species in Blakemore, 2005).

Distribution: Endemic to Holarctic, from Vancouver Island to Japan; several species cosmopolitan by introduction.

Bimastos parvus (Eisen, 1874)

Allolobophora parva Eisen, 1874: 46. Locality Mt Lebanon, New York. Types in US National Museum.

Allolobophora beddardi Michaelsen, 1894: 182. Locality USA. Types Hamburg: 153.

Allolobophora parva udei Ribaucourt, 1896: 80. Locality Heustrich, Switzerland. Types?

Allolobophora constricta var. *germinata* Friend, 1897: 1. Co. Antrim, Ireland. Types?

Eisenia parva : Pop, 1948: 89, 123 [misidentification of *A. eiseni* according to Csuzdi & Zicsi, 2003: 70]; Bouché, 1972: 386; Zicsi, 1982: 436.

Bimastos parvus : Gates, 1972: 87 (syn. *beddardi*, ?*longicinctus*); Easton, 1981: 41 (syn. *beddardi*); Sims & Gerard, 1985: 48; 1999: 48; Csuzdi & Zicsi, 2003: 69.

Allolobophora parva : Easton, 1983: 475 (syn. *beddardi*, *parva udei*, *constricta germinata*).

Distribution: Cosmopolitan species indigenous to Palaearctic (NE USA); fairly common in Japan. Current specimens from Okutama (collected 26th May, 2003 by R.J.B. under plant pots in carpark of hotel in Okutama) and Kuzuharagaoka Shrine, Kamakura, Japan (specimen collected from drain 13.vi.2004 by RJB, Amanda Reid and Yuko Hiramoto).

Remarks: Easton (1983) appears to ignore the synonymy by Gates (1972) in *Bimastos*

parvus of *Bimastos longicinctus* Smith & Gittings, 1915 that he instead retains provisionally in *Eisenia*. According to Easton (1983), *Allolobophora parva* Eisen, 1874 replaces *Eisenia parva* or *Bimastos parvus*, but current workers still use either of these names, and more recently this taxon was briefly transferred to the genus *Allolobophoridella* Mršić, 1990 before its return to *Bimastos* by Csuzdi & Zicsi (2003: 69).

***Aporrectodea rosea* (Savigny, 1826)**

Enterion roseum Savigny, 1826: 182.

Eisenia rosea: Easton, 1981: 44.

Aporrectodea rosea : Easton, 1983: 477.

Distribution: Cosmopolitan species, indigenous to Palaearctic; reported from Hokkaido.

Remarks: This species is widely distributed around the world mainly by introduction and has very numerous synonymies, including several from Kobayashi (1940), (e.g., see Gates, 1972, 1974; Sims & Gerard, 1985; 1999; Blakemore, 2002; 2004; 2005). The Japanese records, however, were thought dubious by Stop-Bowitz (1969: 190).

***Aporrectodea caliginosa* species-group sensu Blakemore (2002).**

Included species reported from Japan:

***Aporrectodea caliginosa* (Savigny, 1826)**

***Aporrectodea trapezoides* (Dugès, 1828)**

***Aporrectodea tuberculata* (Eisen, 1874)**

Distribution: Cosmopolitan species, indigenous to Palaearctic; several reports from Japan.

Remarks: All three of the above species have been reported as introductions to Japan: the first two, *A. caliginosa* and *A. trapezoides*, are cited by Easton (1981) and the third, *A.*

tuberculata, is tentatively derived from Kobayashi's studies (published in 1940; 1941a, 1941b, 1941c) that listed *A. caliginosa typica* from Manchuria, Korea, and Japan although he may actually have been referring to *A. tuberculata* according to assessments by Gates (1972: 81) and by Shih *et al.* (1999: 439).

Dendrobaena octaedra (Savigny, 1826)

Enterion octaedrum Savigny, 1826: 183.

Distribution: Cosmopolitan, indigenous to Holarctic; recoded from Sapporo and Hidaka, Hokkaido (endemic?) by Easton (1981), and Fujikawa Shizuoka-ken by Nakamura *et al.* (1989).

Remarks: Parthenogenetic polymorphs are common (Sims & Gerard, 1985; 1999: 72).

Dendrobaena pygmaea (Savigny, 1826)

Enterion pygmaeum Savigny, 1826: 183.

Distribution: Indigenous to western Europe. This is the first record from Asia: from Yohohama National University campus (Coll. & Det.: R.J. Blakemore, 9-10th May, 2003).

Remarks: This taxon along with *D. attemsi* (Michaelsen, 1902) and *D. octaedra* (Savigny, 1826: 183) may form a parthenogenetic species-complex, possibly also involving the biparental *Satchellius mammalis* (Savigny, 1826: 181) in which case this latter species name would take overall priority (see Blakemore, 2002; 2003a,b).

Dendrodrilus rubidus species-complex sensu Blakemore (2002).

Included subspecies reported from Japan:

Dendrodrilus rubidus rubidus (Savigny, 1826)

Dendrodrilus rubidus tenuis (Eisen, 1874)

Distribution: Cosmopolitan species-complex, probably indigenous to Holarctic as fossil cocoons were found in postglacial deposits in Ontario (Schwert, 1979). In Japan, found mainly in Hokkaido and northern Honshu with new records from current study at Okutama and Yamanashi-ken in central Honshu.

Remarks: Full synonymies of subspecies and morphs may be found elsewhere (e.g. Blakemore, 2002).

Eisenia fetida species-complex sensu Blakemore (2002)

Included species reported from Japan:

Eisenia andrei Bouché, 1972 (nom. nov. pro *fetida* var. *unicolor* Andre, 1963)

Eisenia fetida (Savigny, 1826)

Distribution: Cosmopolitan species, indigenous to Palaearctic.

Remarks: *Eisenia andrei* is a molecular species that currently can be differentiated from *E. fetida* only by electrophoresis, indeed Easton (1983) considered it a junior synonym of *E. fetida*, and both taxa have morphs and/or ecotypes that overlap morphologically (Sims & Gerard, 1985; 1999). Moreover, it is possible that *Eisenia nordenskiöldi* (Eisen, 1874) is also implicated, either in synonymy or within the species-complex (see Gates, 1972: 103; Blakemore, 2002: 317). The *Eisenia fetida* species-complex is employed in vermicultural, laboratory and ecotoxicological studies around the world, including Japan (pers. obs.), although the names *fetida* and *andrei* are interchanged rather indiscriminately and the invalid “foetida” spelling persists in some reports. The first Japanese report was by Michaelsen (1892: 230).

Eisenia japonica (Michaelsen, 1891)

Allolobophora japonica Michaelsen, 1891: 6; 1892: 230. Type locality Japan (Enoshima, Hakodate, and Fuji-san). Types in Hamburg: 119-122, other material was stated by Michaelsen (1892) to be in Zoological Museum, Berlin: listed by Hartwich & Kilius (1989: 268) as 2115 from Hakodate (a syntype lost after loan to Turin Museum in 1893), and 2117 from Enoshima (8 syntypes).

Helodrilus (Allolobophora) japonicus : Michaelsen, 1900: 481.

Allolobophora japonica f. *gigantica* Oishi: 1934:134.

Allolobophora japonica f. *minuta* Oishi: 1934:134.

Eisenia japonica : Easton, 1981:43; Easton, 1983: 480 (syn. *japonica gigantica*, *japonica minuta*).

Diagnosis: Lumbricine setae closely paired. Setae ab on 22 and 25 in tumid pads (Michaelsen). Spermathecal pores in 9/10/11 in c or cd lines. Clitellum 23,24-31. Tubercula pubertatis as low elongate markings on 25,26,27-29 and usually as raised papillae on 27 and 29. Specimens collected from Lake Biwa (by RJB 1st Feb, 2007) had some variation in genital papillae one having paired papillae on one side and a single papilla on 27 on the other.

Distribution: considered endemic to Japan (Hokkaido to Kyushu), Korea and possibly China (e.g. from Sansei by Ohfuchi, 1951: 62), despite a report from Europe (Germany, Graff, 1954); also listed in a Red Data Book of the Russian Federation (Anon, 1997) since its recording on south Sakahlin Island (Perel, 1979: 78) so it may yet be an introduction, possibly from eastern Siberia, or have a wide natural range.

Remarks: Easton (1981: 43) mistakenly cites the publication as “Michaelsen, 1892: 230”, but this is corrected in Easton (1983). The three “varieties” of this species were listed by

Easton (1981: 43) and, even though ICZN (1999, Art. 45.6.4) allows such names published before 1961 to assume sub-specific rank, they were later combined under *E. japonica* by Easton (1983:480). Gates (1975) provides a detailed account of this species. A congener also known from the region is *Eisenia koreana* (Zicsi, 1972), that is sometimes returned to its original genus of *Eiseniella*, which has these characters (Cs. Csuzdi pers. comm.): clitellum 25-31, TP 27-28, male pores on 15 in glandular region that extends into adjacent segments, length 30-35 mm, and a dark brown colour.

Eiseniella tetraedra tetraedra (Savigny, 1826)

Taxonomic Notes: Easton (1983) has these subspecies: *Ei. tetraedra intermedia* Cernosvitov, 1934 [non Jackson, 1931] - the junior homonym now *Ei. tetraedra cerni* Blakemore, 2004 (replacement name); *Ei. t. neapolitana* (Örley, 1885) syn. ?*ninnii* Rosa, 1886; *tetraedra sewelli* Stephenson, 1924 (from Italy, California, Middle East) and recently elevated to species level by Csuzdi & Pavlicek, 2005; and *Ei. t. pupa* (Eisen, 1874) syn. *hercynius* Michaelsen, 1890; *tetraedra quadripora* Cernosvitov, 1942. The latter subspecies, *Ei. t. pupa*, is recorded from Niagra; Germany; Portugal; USA (California and Illinois); England (Tring, Hertfordshire; Ashby-de-la-Zouche, Leicestershire); and Fifeshire, Scotland; - it has male pores on 12 or 15 as do morphs of some other sub-species. According to Csuzdi & Zicsi (2003: 153-157) either *Ei. t. pupa* (which they have as junior synonym of "*Eis. t. hercynia*") and *Ei. t. cerni* are in synonymy of *Ei. tetraedra*, or they are separate subspecies, or merely morphs; however, the only differences of several *tetraedra* taxa are the locations of the male pores they could be varieties rather than subspecies. Variations are usually thus:

Ei. t. cerni Blakemore, 2004 male pores on 14.

Ei. t. tetraedra (Savigny, 1826) male pores on 13.

Ei. t. pupa (Eisen, 1874) male pores on 12 or 15.

Distribution: Western Palaearctic (possibly endemic in north Balkans – Gerard), Scandinavia to Pri-urals; Adriatic and Mediterranean, many locations, eg. a spring at Mt Meon, Galilee, Israel (Csuzdi & Pavlicek, 2005) etc.; now introduced into mainly temperate regions including northern Nearctic (eg. Canada, Pennsylvania, California), also the Levant; southern South America [eg. Chile - Navarino Island where in 1830 Captain Fitzroy commanding the "Beagle", landed and took 4 young Fuegian hostages in retribution for a stolen boat, returning them on the "Beagle's" 2nd trip with Charles Darwin in January, 1833, and revisiting again in March, 1834] south of Tierra del Fuego, Chile - (Anderson & Hendrix, 2003), and remote Juan Fernández Islands (now renamed by the Chilean government as “Robinson Crusoe Islands” to commemorate the story of the same name based on Alexander Selkirk’s sojourn there); Azores; Canary Islands; Cape Verde; St Helena; Tristan de Cunha; Mexico; Colombia at 3,000m (Feijoo *et al.*, 2004); South Africa; Morocco; Libya; Iran, Afghanistan, Tajikistan; etc. India; New Zealand and Australia: infrequently reported from south-western WA [*Eiseniella intermedius* (*sic*) Jackson, 1931 synonymised by Michaelsen, 1935a: 40; Easton, 1983], NSW (Michaelsen, 1907a; Barley & Kleinig, 1964), Brownhill Creek in SA (J. Buckerfield, pers. com.), Macquarie Island and New Zealand, (Lee, 1959: 364), but not recorded from Qld. Current specimens were found in Vict. and Tasmania (new records); Taiwan and Toyama-ken, Japan (new records). Species details and description in Blakemore (2002).

Genus *Lumbricus*

Remarks: Easton (1981: 44) lists “*Lumbricus* sp. Ohfuchi, 1941: 255” from Honshu, but

these specimens did not have tanylobous prostomia (excluding them from *Lumbricus*), they appear highly variable and, because they were un-named, are not part of a species checklist. Nakamura (1999a: vii, 108) shows a photograph of *Lumbricus terrestris* Linnaeus, 1758 from his specimen collection, and he further records *Lumbricus rubellus* Hoffmeister, 1842/3 as being imported into Japan for vermiculture. Neither of these species is confirmed because there is no statement that *L. terrestris* is actually from Japanese material, and *L. rubellus*, although often claimed, has never been confirmed in vermiculture and is most often a misidentification of *Eisenia fetida* (see Blakemore, 1999).

Family Ocnerodrilidae

Eukerria saltensis (Beddard, 1895)

Kerria saltensis Beddard, 1895: 225. [Type locality Salto, Valparaiso, Chile. Types in US National Museum (21025) and British Museum 1904:10:5:928)]. – Michaelsen, 1900: 371. - Michaelsen, 1907a: 23 (syn. *sydneyensis*).

Acanthodrilus sydneyensis Sweet, 1900: 124 (from Fletcher's 'Museum Name' according to Michaelsen, 1907a) Types?

Kerria gunningi Michaelsen, 1913. Types in Hamburg: 7490.

Kerria nichollsi Jackson, 1931:121, Pl. XVI, figs. 5,8,9,11. Types?

Eukerria saltensis. – Michaelsen, 1935a:40 (syn. *nichollsi*, *sydneyensis*); 1935b:103 (syn. *nichollsi*). - Gates, 1942: 67 (syn. *gunningi*). – Gates, 1972: 270.

Taxonomic note: Often misdated as "Beddard, 1892" when other *Eukerria* species were described by this author. Full details and description in Blakemore (2002).

Distribution: South America and spread worldwide by human and other agencies; in Asia

only known from Myanmar and, now, from Kamakura/Machida and Biwako, Japan - **New records Japan.**

Economic note: in Australian rice paddies where they were abundant and thought to be rather problematic as they attracted wading birds such as *Ibis* spp. which muddied the water (M. Stevens *pers. comm.* see www.ricecrc.org/reader/rice-crc/Oligochaeta_sludge.htm www.ricecrc.org/reader/rice-crc/Oligochaeta_coccoons2.htm and Stevens & Warren, 2000).

Japanese specimens were collected from a road-side drainage channel at Kuzuharagaoka Shrine, Kamakura, and a river in Machida, Tokyo (details in Blakemore *et al.*, 2007). Further new records are from Fudogawa, Ojiyamakoen, Biwako (collected 31.i.2007 and 1.ii.2007 by R.J.B.); similar specimens collected from Kochi, Shikoku Island in 2002 were too damaged to reliably identify. It is not known if their spread into Japanese rice fields, where the rice is generally transplanted unlike in Australia, is likely to be problematic or not.

***Ocnerodrilus occidentalis* Eisen, 1878**

Ocnerodrilus occidentalis Eisen, 1878: 10, figs. 1-20. From Fresno, California. Types missing from Zoological Museum, Berlin: 2363.

Ocnerodrilus occidentalis : Easton, 1981: 45.

Distribution: Cosmopolitan species (indigenous to Neotropics), widespread in Japan and on Okinawa.

Remarks: Small species often overlooked. Gates (1972: 274) considered *Ocnerodrilus occidentalis* to be a parthenogenetically degraded species complex.

Family Acanthodrilidae

Genus *Microscolex* Rosa, 1887

Microscolex phosphoreus (Dugès, 1837)

Lumbricus phosphoreus Dugès, 1837: 17. Type locality in greenhouses of Jardin des Plantes, Montpellier, France. Types: none known.

Microscolex phosphoreus : Easton, 1981: 45.

Distribution: Cosmopolitan species (indigenous to South America), widespread in Japan.

Remarks: Small and often overlooked with only a few reports from Japan (Easton, 1981).

Family Octochaetidae

Genus *Dichogaster* Beddard, 1888

Dichogaster (Diplothecodrilus) bolau (Michaelsen, 1891)

Benhamia bolavi Michaelsen, 1891: 9 (corr. *bolau*). Type locality Bergedorf near Hamburg. Types in Hamburg: 285, and Berlin: ZMB 7334 (fragments from 2 desiccated syntypes); also others listed in Reynolds & Cook (1976: 80).

?*Dichogaster hatomaana* Ohfuchi, 1957: 259. From Hatoma-jima, Ryukus. Types unknown.

Dichogaster bolau : Easton, 1981: 46.

Dichogaster (Diplothecodrilus) bolau : Csuzdi (1995) (syn. *hatomaana*).

Distribution: Cosmopolitan species (indigenous to Africa); a Japanese report from Okinawa by Kobayashi (1941), and possibly Hatoma-jima if synonymy of *hatomaana* is correct (cf. *D. saliens*).

Remarks: Small species often overlooked.

Dichogaster (Diplotheodrilus) saliens (Beddard, 1893)

Microdrilus saliens Beddard, 1893: 683. From Kew Gardens, London. Types lost?

?*Dichogaster hatomaana* Ohfuchi, 1957: 259.

Dichogaster saliens : Easton, 1981: 46 (syn. *hatomaana*).

Dichogaster (Diplotheodrilus) saliens : Csuzdi (1995).

Distribution: Cosmopolitan species (?indigenous to Africa), possibly reported once from Ryukyus: some specimens collected from Hatoma-jima, near Iriomote, on April 1st, 1936.

Remarks: Small and often under-reported (see Blakemore, 2002). Synonymy by Csuzdi (1995) of *Dichogaster hatomaana* Ohfuchi, 1957 in *D. bolau* rather than *D. saliens* as determined by Easton (1981) would, if so, remove this species from the Japanese list.

The description by Ohfuchi (1957) is ambiguous as he first says female pore single, then that the "oviducts opening separately, each one on a papilla occupying the whole width of the segment [14]" - this also shown in his fig. 25. On balance, and because only one pair of prostates were reported, I believe the species concerned is probably *D. saliens* rather than *D. bolau*. It is highly unlikely that the confused account reports a new taxon.

Family Megascolecidae

Diagnosis (after Blakemore, 2000; 2002): male pores united with prostatic pores, paired or occasionally unpaired, commonly on 18 (rarely on 19 or 20). Prostates tubular to racemose. Nephridia holoic or meroic. Setae lumbricine to perichaetine. Dorsal pores present or absent. Oesophageal gizzard(s) usually present; calciferous glands present or absent; intestinal gizzard(s) and caeca sometimes present. Spermathecae single, paired, or multiple; diverticulate (or rarely with intramural sperm chambers).

Distribution: Australasian region (Australia, New Zealand); India; Asia and Oceania; North and Central America; many species peregrine, particularly some of the 400+ Oriental pheretimoids. Pheretimoid species are readily identified by the presence of an oesophageal gizzard after 7/8 (except for the monotypic genus *Pleionogaster* from the Philippines that has intestinal gizzards), combined with the apomorphic character states of racemose prostates, perichaetine setae, and meroic nephridia.

Remarks: Much misunderstanding and controversy has concerned the varied definitions and scope of the family Megascolecidae. The most current revision above is from Blakemore (2000) where this family is separated from Acanthodrilidae, Octochaetidae and the newly defined Exxidae Blakemore, 2000. These latter three families have an acanthodriline arrangement of male pores and nephridia that are either holoic, in Acanthodrilidae, or meroic in Octochaetidae and Exxidae, with Exxidae distinguished by its non-tubular prostates.

Many classical species names were transferred to *Pheretima* from the genus *Perichaeta* Schmarda, 1861 (type species *P. leucocyta* Schmarda, 1861; Synonyms *Perichoeta* : Vaillant, 1867; *Pericheta* : Perrier, 1874) which has long been combined as a junior synonym of the Sri Lankan genus *Megascolex* Templeton, 1844, for reasons explained by Horst (1883:182) and Sims & Easton (1972: 175). Two other pheretimoid genera: *Nitocris* Kinberg, 1867 and *Rhodopis* Kinberg, 1867 were preoccupied (see Sims & Easton, 1972: 178).

In view of the apparent confusion and dissenting opinions regarding the current classification of Japanese pheretimoids, each genus is summarized below from the works of Sims & Easton (1972), and Easton (1979; 1981; 1982; 1984), followed by Japanese species lists. The first two genera, *Pontodrilus* and *Perionyx*, are relatively primitive in

having plesiomorphic holoic nephridia and are not pheretimoids.

Genus *Pontodrilus* Perrier, 1874

Type species and locality: *Lumbricus litoralis* Grube, 1855, (syn. *Pontodrilus marionis* Perrier, 1874), originally described from shoreline of Mediterranean at Villafranca, Nizza, and Marseilles, in southern France.

Diagnosis (from Blakemore, 2000): Megascolecid with tubular prostates, lumbricine setae and holoic nephridia that are characteristically absent from anterior segments.

Dorsal pores, calciferous glands, intestinal caeca, and intestinal gizzards absent.

Distribution: *Pontodrilus litoralis* is circummundane – on shorelines in the tropics and warmer parts of continents and islands in the Atlantic, Pacific and Indian Oceans, from the Mediterranean, South China Sea, and Red Sea; one species is lacustrine in New Zealand; two species are terrestrial, one in Sri Lanka and one in China. A fifth species, the newly described littoral *Pontodrilus primoris* Blakemore, 2000, is from north-eastern Tasmania. Having a second littoral species from Tasmania puts Australia, with its large and often tropical coastline, in contention for the provenance of the genus.

Remarks: *Pontodrilus* is ascribed to the family Megascolecidae sensu Blakemore (2000) rather than Acanthodrilidae where it had been placed by some earlier authors.

Pontodrilus litoralis (Grube, 1855)

Lumbricus litoralis Grube, 1855: 127-129, figs. 5-10 [et *littoralis* Grube, 1855; nec Dalyell, 1853]. Type locality Villa franca in French Riviera. Syntype in Zoological Museum, Berlin: 216 - dried out according to Hartwich & Kilius, (1989: 270) but perhaps still useable for DNA analysis.

Pontodrilus marionis Perrier, 1874: 1582. Types unknown.

Pontodrilus bermudensis Beddard, 1891: 96. Types in Bruxelles, Belgium.

Pontodrilus matsushimensis Iizuka, 1898: 21; Easton, 1981: 45. Types unknown.

Pontodrilus matsushimensis chathamensis Michaelsen, 1899: 220. Types in Otago Museum, NZ.

Plutellus (Pontodrilus) matsushimensis indica Michaelsen, 1935: 106. Types unknown.

Pontodrilus litoralis : Easton, 1984: 114 (syn. *bermudensis*, *matsushimensis*, *albanyensis*, *cygni*, *indica* Michaelsen, 1935, *gracilis*).

Remarks: For full diagnosis, distribution and discussion of synonymy, see Easton (1984: 114-116) and Blakemore (2000; 2002). It is remarkable that specimens collected in 2003 from the south beach of Jogashima on the Miura Peninsula, Japan, agreed with material previously inspected by the author from NSW, Australia and from the Galapagos Islands.

Genus *Perionyx* Perrier, 1872

Type species and locality: *Perionyx excavatus* Perrier, 1872: 126 from Vietnam.

Diagnosis (from Gates, 1972): Megascolecid with racemose prostates, perichaetine setae and holoic nephridia. Gizzard absent or weak in segment 5; calciferous glands, intestinal caeca, and intestinal gizzards absent. Dorsal pores present.

Distribution: Home territory in Himalayan region; two species widely transported.

Perionyx excavatus Perrier, 1872

Perionyx excavatus Perrier, 1872: 126. From Saigon. Types in Paris Museum.

Perionyx excavatus : Michaelsen, 1900: 208 (syn. *gruenewaldi*); Gates, 1972:141 (syn.

fulvus, ?*koboensis*, ?*turaensis*); Sims & Gerard, 1985: 134 (syn. *Perionyx* sp. Friend, 1911:188).

Perionyx gruenewaldi Michaelsen, 1891: 33, fig. 6. Types (from Sangir) in Leiden Museum, and Zoological Museum, Berlin: 1914 (5 syntypes).

Perionyx fulvus Stephenson, 1916: 322. Types missing.

Distribution: Cosmopolitan species (indigenous to Himalayan region).

Remarks: A reference by Nakamura & Zicsi (1999) reporting *Perionyx excavatus* from Tokyo is not unexpected as this species is often used in vermicomposting operations around the world and since it is also recorded from Korea (http://earthworm.chonbuk.ac.kr/db_list/list_eng.asp). For full descriptions see Gates (1972), Blakemore (1994; 1999; 2002).

Genus *Amyntas* Kinberg, 1867

Type species and locality: *Amyntas aeruginosus* Kinberg, 1867 from Guam.

Taxonomic note: Kinberg (1867) spelt the genus name *Amyntas* (p. 97) and *Amyntas* (p. 101), the former spelling has priority, the latter was preoccupied. Moreover, *Amyntas* has priority as "page or position precedence" (ICZN, 1999: 69A.10) over *Pheretima* Kinberg, 1867: 102 (see also Sims & Easton, 1972: 176). *Amyntas aeruginosus* Kinberg, 1867 is particularly similar to *A. taitensis* (Grube, 1866) and, if they eventually prove to be synonymous, the latter name has priority as discussed by Blakemore (2002).

Diagnosis (from Sims & Easton, 1972): Pheretimoids with an oesophageal gizzard in 8-9 and intestinal caeca usually originating near 27 (if originating in 25 then holandric species only, cf. metandric *Begemius*); intestinal gizzard absent. Setae perichaetine. Male pores

superficial, never within copulatory pouches. Nephridia meroic, usually absent from the spermathecal ducts.

Distribution: Oriental region; of about 400 nominal species, at least ten are peregrines.

Remarks: The dominant genus in Asia, including Japan. A premise in the revision by Sims & Easton (1972: 214; 268) was that species were assumed to belong to *Amyntas* rather than *Metaphire* or *Pheretima* unless re-examination of types shows them to have copulatory pouches; thus they attributed specimens lacking male pores to *Amyntas* by default.

Concerning *Amyntas/Metaphire*, the division is straightforward when we have clear differences such as in *M. schmardae* (that has copulatory pouches with huge eversible "air-bags" with glands and penes as are found in *M. bipora*, *M. virgo* and possibly *M. malayana*), but naturally there are sometimes borderline cases that are difficult to classify. An answer is to simply ask "are the male pores superficial (= *Amyntas*), or are they non-superficial (= not *Amyntas*)" and in support I quote Gates (1975: 7) concerning this question:

"Presence or absence of copulatory chambers is too vague. The really important character is whether the male pores are superficial or invaginate. In the latter case, whether in slight transverse slits of much deeper spaces still confined to the parietes or whether thick-walled copulatory chambers deeply penetrating into coelomic cavity (cf Gates, 1972: 150)".

Complicating factors are that parthenogenetic morphs may lack male pores completely or, as stated by Easton (1982: 725), the techniques used to preserve specimens may cause copulatory pouches to evaginate making the male pores appear superficial, and in immatures the copulatory pouches may be undeveloped.

Pheretima species erected by Ishizuka (1999-2001) (see Table 2 below) are

mostly transferred to either one or other of these genera.

Amyntas carnosus (Goto & Hatai, 1899)

[Fig. 2](#) *Amyntas carnosus* (Goto & Hatai, 1899): top Goto & Hatai's original Fig. 4; bottom *Ph. kyamikia* Kobayashi, 1934.

Perichaeta carnosa Goto & Hatai, 1899: 15, fig. 4. From Tokyo (the exact locality unknown; however, the authors worked at the First High School, Tokyo which is in Shibuya). Types none.

Pheretima carnosa : Michaelsen, 1900: 260; Kobayashi, 1936b (syn. *pingi*, *kyamikia*); Chen, 1936: 274 (when describing *P. pingi chungkingensis*, that now probably merits elevation to species level, remarked that *pingi* was probably a synonym of *carnosa*); Ohfuchi, 1937b: 56, fig. 9; Kobayashi, 1938: 161; Chen ?1959: 9, fig. 9 (syn. *pingi*); Ishizuka, 2001: 75, fig. 32; Nakamura, 1994: 27 (name misspelt “canosa”).

?*Pheretima pingi* Stephenson, 1925: 891, text fig. 1 (of testis sac), plate II fig. 7 (of a possibly parasitised spermatheca); Michaelsen, 1931: 11; Stephenson, 1931: 55; Chen, 1933: 228, fig. 15; Gates, 1943: 103; Ishizuka, 2001: 82, fig. 46 – looks exactly the same as *P. carnosa* in fig. 9 of Chen (?1959).

Pheretima kyamikia Kobayashi, 1934: 1, figs. 1-3. From Korea. [Kobayashi's fig. 1 is almost exactly the same as Chen (?1959: fig. 9 variations). The name is from its Korean name “kyamiki” meaning “dog bait” or “useless as fishbait”].

Amyntas carnosus: Sims & Easton, 1972: 235 [in *A. hawayanus* (= *gracilis*) group]; Blakemore, 2003: 13 and 43 addenda (syns. ?*distichus*, *kyamikia*, ?*youngtai*, *sangyeoli*); Shen *et al.*, 2003: 484 (syn. *sangyeoli*); Shen *et al.*, 2005: 95, fig. 1

(syn. *kyamikia, sangyeoli*) – their fig. 1 is reminiscent of both Chen (1933; fig. 15) of *P. pingi* and Shen *et al.* (2003 fig. 3) of *A. nanshanensis*.

?*Amyntas youngtai* Hong & James, 2001: 269, fig. 1A-C [segments miscounted]. From Korea.

Amyntas sangyeoli Hong & James, 2001: 271, fig. 3A-C. From Korea.

?*Amyntas nanshanensis* Shen *et al.*, 2003: 483, fig. 3, tab. 2. From Taiwan.

?*Amyntas monsoonus* James *et al.* 2005: 1012. From Taiwan.

Diagnosis: Usually four pairs of obvious spermathecal pores in 5/6/7/8/9 [or occasionally three pairs in 6/7/8/9 as noted by Chen (1933: 233) or questionably in just 5/6/7/8]. Genital markings closely paired anteriorly in some of 7,8-9 and sometimes also in 18 and 19 often with another pair posteriorly on 18 just median to the line of the male pores. [Chen (1933: 231) for *P. pingi* allows papillae rarely absent, one to three pairs (occasionally up to five pairs) usually placed around male pores: two pairs on segment 18 in front and behind the setae and one pair on 19 in front of setae, the post-setal pair on segment 18 often close to male pores while the ante-setal pair on both segments either laterally or medially. Often paired on 8 and 9, those on 8 placed either ante- or post-setally if only one pair present, or on both sides of the setal line if two pairs present; one or occasionally two pairs on 9 generally placed ante-setally (seldom present post-setally on 9 and ante-setally on 10) – these papillae paired either latero-ventrally or medio-ventrally]. Intestinal caeca simple. Spermathecae usually four pairs, anterior pair often smaller; diverticulum clavate.

Distribution: Japan (Goto & Hatai, 1899; Ohfuchi, 1937; Easton, 1981), Korea and Quelpart Island (Kobayashi, 1934; 1936; 1938); and, in addition to these locations: from China - Jiangsu, Zhejiang, Anhui, Shandong, Hong Kong, Sichuan, and Beijing (citation

below). Vietnam as *P. pingi*. Recently claimed from Taiwan by Shen *et al.* (2005), while the Taiwanese taxon *A. nanshanensis* Shen *et al.*, 2003 is also similar (perhaps differing only in earlier dorsal pores commencement from 5/6 rather than 11/12 or 12/13) as is their *A. penpuensis* that however lacks Genital Markings (cf. *A. corticis*) [see <http://www.sinica.edu.tw/zool/zoolstud/42.4/479.pdf>; <http://wwwdb.tesri.gov.tw/protect/UpLoadPic/051105232/05110523295/05110523295.pdf.pdf>]. Possibly endemic to Japan and Korea, and introduced to China and Taiwan, unless, as Chen (1936: 275) first suggested when describing *A. pingi chungkingensis*, that *A. pingi* is a synonym of *A. carnosus*, in which case this taxon may be more prevalent in China and its centre of origin more obscure. Gates (1943) describes a single specimen of *Pheretima pingi* from 3,000-5,000 ft at Kuatun, Fukien China and makes no mention of the supposedly distinctive tubercles on the spermathecae. The genital markings of this specimen were about coincident with the spermathecal and male pores plus another two pairs just median to the male pores, one presetal and one postsetal, the latter in contact with but distinct from the male porophore.

Remarks: A problem with the original description was that the spermathecal pores were described in 5/6/7/8 but spermathecae were stated to be in 7,8,9 suggesting they exited in 6/7/8/9 or possibly one set was missed and they were actually in 5/6/7/8/9. While Gates (1972: 149) implied this taxon and *P. kyamikia* Kobayashi, 1934 might be the same as *Megascolex diffringens* Baird, 1869 [= *Amyntas corticis* (Kinberg)] that has four pairs of spermathecal pores, Easton (1981: 50) tentatively included *P. carnosa* in synonymy of *Amyntas gracilis*, apparently accepting three pairs of spermathecae in 5/6/7/8 as per the original description and as restated by Michaelsen (1900: 260). Nevertheless, Ohfuchi (1937b: 56-62, fig. 9) in a more detailed description, shows it with four pairs of

spermathecae in 5/6/7/8/9 and with variations in markings that encompass Kobayashi's *P. kyamikia*, thus it appears different from both *A. gracilis* and *A. corticis* by its markings described as more closely paired, almost mid-ventral, in 7,8-9 and 18, 19. Ishizuka (2001: 75) also figures *carcosa* with four pairs of spermathecae in 5/6/7/8/9 and with markings paired in 8 (two sets), 9, and 18 (two sets); while Ishizuka (2001: 82) figures “*Pheretima pingi* Chen, 1936” that looks exactly the same as Chen's fig. 9 of *Pheretima carnosus*. It is restored from Easton's synonymy in the present account. [The Chinese distributions above are from Chinese Agricultural Academy of Science website <http://www.agrionline.net.cn/zhuanti/index.htm> whence *Pheretima carcosa* is described with either three or four pairs of spermathecae in 5/6/7/8,8/9]. Ishizuka's *Amyntas distichus* is similar to the octothecal forms.

Hong & James' (2001b) *A. sangyeoli* does not differ from Ohfuchi's (1937b) redecription of *A. carnosus* where the spermathecae are located in 5/6/7/8/9, and their *Amyntas youngtai* (that has its figured segments miscounted) is also sufficiently similar to be included in synonymy of *carnosus*. The former of these synonyms was also independently determined by Shen *et al.* (2003b: 484, Tab. 2).

Amyntas monsoonus James *et al.* 2005: 1012 from Taiwan is also possibly in synonymy of *A. carnosus* as it has the same classical markings in 7-9 and spermathecae in 6/7/8/9.

***Amyntas conformis* (Ishizuka, 2000).**

Pheretima conformis Ishizuka, 2000e: 182.

Pheretima monticola Ishizuka, 2000e: 191-193, figs. 60-66, tab. 1. [This junior primary homonym of *Pheretima monticola* Beddard, 1912 (= *Polypheretima monticola*) is

permanently invalid under ICZN (1999: Art. 57.2, 60) but is not replaced as a senior synonym exists].

Diagnosis: Spermathecal pores in 5/6/7/8/9. Male pores superficial. Genital marking large, paired on 10 and 17, at least. Intestinal caeca simple; [note: in the current study, a specimen from Yamanashi was identified with this taxon, but it differed by having incised caeca].

Distribution: Japan.

Remarks: Approximately 50 *Amynthas* species have spermathecae in 5/6/7/8/9 including members of the *Amynthas corticis* species-complex, for which this species may well qualify for inclusion (as with Ishizuka's almost identical specimens given the invalid name of *P. monticola*), although Ishizuka (2000e: 185) compares his species only to *Amynthas brevicingulus* (Chen, 1938) that has spermathecae in 5/6/7/8 and belongs to the *Amynthas hawayanus* (= *gracilis*) group of Sims & Easton (1972). Ishizuka (2000e) makes no comparison with his subsequent *P. monticola* [non Beddard, 1912] despite the obvious similarities that suggest these specimens belong with the name *conformis*, wherever it eventually resides. Recently Dr M.T. Ito (pers. comm. 9/12/04) suggested the possibility that it belongs in synonymy with *A. yamizoyamensis* (Ohfuchi, 1957).

Amynthas corticis species-complex

Included species from Japan.

Amynthas corticis (Kinberg, 1867)

Perichaeta corticis Kinberg, 1867: 102. Type locality Oahu. Types in Stockholm: 1947.

Megascolex diffringens Baird, 1869a: 40, figs. 1-3 & 1869b: 387 Type locality Plas Machynlleth, North Wales. Syntype in British Museum: 1869:1.2.1.

?*Megascolex (Perichaeta) sanctaehelenae* Baird, 1873: 272. Type locality St Helena.

Perichaeta subquadrangula Grube, 1877: 553 [due to its poor description, Sims & Easton (1972: 224) had this species name (with incorrect date as 1868: 36) as *incertae sedis*, but Easton (1979: 119; 1984: 118) placed it in synonymy of *corticis*]. Type locality Rewa River, Viti Levu, Fiji. Holotype in Zoological Museum, Berlin: 705.

Megascolex indicus Horst, 1883: 186 [non *Perichaeta indica* : Horst, 1885: 4 (= *Pheretima darnleiensis*) from Sims & Easton (1972: 260)]. Types in Leiden Museum: 1917-1918.

Perichaeta indica : Michaelsen, 1892: 241. Specimen from Japan.

Pheretima indica : Michaelsen, 1900: 275 [syn. *californica* (part.) [laps.], ?*corticis* [laps.], *heterochaeta*, *nipponica*].

Perichaeta peregrina Fletcher, 1887: 969. Type locality Sydney believed introduced from Mauritius. Types in Australian Museum. [Name misspelt “peregrinus” by Nakemura (1994: 27)].

Pheretima peregrina : Michaelsen, 1900: 293 (syn. ?*molokaiensis* Beddard, 1896); Lee, 1959: 327 (syn. *campestris* Lee, 1952 [non Goto & Hatai, 1898]).

?*Perichaeta mirabilis* Bourne, 1887: 668 (669?). Locality Naduvatam, East Indies. Types?

Perichaeta heterochaeta Michaelsen, 1891: 6 (non *Megascolex heterochaetus* Michaelsen, 1918: 25). Types missing.

(*Perichaeta ijimae* Rosa, 1891: 402)? From Japan - adiverticulate spermathecae in 5/6/7/8.

[Under the taxon name *ijimae* were united *kamakurensis*, *parvula* and *decempapillata*, all offerings from Goto & Hatai (1898), by Beddard (1900: 636)].

Perichaeta divergens Michaelsen, 1892: 243, fig. 21; Michaelsen, 1900: 264 [syn. ?*fuscata*, ?*campestris*, ?*kamakurensis*, ?*parvula*, ?*heteropoda*, ?*obscura*, ?*sc holastica*, ?*decempapillata* (sic), ?*flavescens*, ?*producta*, ?*miconaria* all of Goto

& Hatai, 1898; (some of these synonyms were revoked by subsequent workers)]. Male pores inconspicuous; prostates absent; spermathecae, sometimes adiverticulate opening in 5/6/7/8/9; GM paired anteriorly in 7, 8 and 9 just medial to the line of the spermathecal pores (cf. *heteropoda*). From Japan. Holotype in Zoological Museum, Berlin: 2116 (lost).

Perichaeta nipponica Beddard, 1892b: 760. From Japan. Type BMNH 1904.10.5.993.

?*Perichaeta molokaiensis* Beddard, 1896: 201. Types?

Perichaeta heteropoda Goto & Hatai, 1898: 69. From Tokyo, Tokorosawa and Kamakura. Types? Spermathecae diverticulate in 5/6/7/8/9, prostates aborted but male pores present; GM paired anteriorly in 6-9 in same line as spermathecal pores.

(*Pheretima marenzelleri* Cognetti, 1906: 780, figs. 5-6; Kobayashi, 1938: 407)? From Yokohama. Types in Vienna?

?*Pheretima silvestrii* Cognetti, 1909: 266. Types in Turin: 194.

Pheretima divergens yunnanensis Stephenson, 1912.

?*Pheretima pingi* Stephenson, 1925b: 891 [cf. *Amyntas carnosus* and *A. fuscatus*].

Perichaeta mirabilis: Gates, 1934: 50 [non Bourne, 1887:669].

?*Pheretima sheni* Chen, 1935: 38 [athecal morphs, cf. *Amyntas robustus*, *A. illotus*]. From Hong Kong; eight specimens three of them aclitellate and all lacking spermathecae. Type described in the Museum of Fan Institute of Biology, Peiping but also claimed in US National Museum: 20181.

?*Pheretima directa* Chen, 1935: 47. Types in U.S. National Museum: 20183.

Pheretima oyamai Ohfuchi, 1937b: 62; Kobayashi, 1938: 409; Ishizuka 2001: 105 [misspelt "oyama"]. From Iwate, Akita and Hokkaido.

Pheretima tajiroensis Ohfuchi, 1938: 46. From Tajiro Is., Miyagi-ken.

?*Pheretima homosetus* Chen, 1938: 414 (sic).

?*Pheretima morii* Kobayashi, 1938: 161.

Pheretima toriii Ohfuchi, 1941: 244, figs. 1-2.

Pheretima clerica Benham 1947. Types unknown.

Pheretima campestris Lee, 1952: 39 [placed in synonymy of *Perichaeta peregrina* Fletcher, 1887 (= *Amyntas corticis*) by Lee (1959: 327) as confirmed by Sims & Easton (1972: 234), nevertheless Nakamura (1999b: 2) proposed the unnecessary substitute name *Pheretima medicampestris* for Lee's species which he took as a homonym of *Perichaeta campestris* Goto & Hatai, 1898 (= *Amyntas robustus*). Under ICZN (1999: Art. 60) this secondary junior homonymy replacement name is unnecessary since available and valid synonyms exist for this taxon].

(*Pheretima hatomajimensis* Ohfuchi, 1957: 245, fig. 20)? From Hatoma-jima, Iriomote, Ryukus. [Name misspelt "hatomajiensis" by Nakamura (1994: 27)].

Pheretima diffringens : Gates, 1972: 149; [syn. (some in part, but not all accepted subsequently) *californica*, *campestris* Lee, 1952, *cingulata*, *clerica*, *corticis*, *divergens*, *heterochaeta*, *heteropoda*, *indica*, *mirabilis*, *molokaiensis*, *nipponica*, *peregrina*, *perkinsi*, *sanctae-helenae*, *silvestrii*, *tajiroensis*, *torii*, possibly also: ?*carnosa*, ?*directa*, ?*homoseta*, ?*kyamikia*, ?*morii*, ?*oyamai*, ?*pingi*]; Gates, 1972: 177 (syn. *heterochaeta*, *divergens yunnanensis*, *mirabilis* : Gates, 1934 [non Bourne, 1887]); Gates, 1972: 217 (?syn. *sheni*); Gates, 1972a: 18,27 (syn. *divergens*, *heterochaeta*, *heteropoda*, *indica*, *nipponica*, *oyamai*, *tajiroensis*, ?*toriii*)

Amyntas corticis : Sims and Easton, 1972: 235; Easton, 1981: 49-50 (syn. *diffringens*, *divergens*, ?*hatomajimensis*, *heterochaeta*, *heteropoda*, ?*ijimae*, *indica* Horst, 1883 [laps. for *indicus*], ?*marenzelleri*, *nipponica*, *oyamai*, *tajiroensis*, *toriii*); Easton

1982: 726-728 (syn. *diffringens*, *peregrina*, *heterochaeta*); Easton, 1984: 118 (syn. *subquadrangula*); Sims & Gerard, 1985: 128; 1999: 128 (syn. *diffringens*, *indicus* Horst, 1883, *nipponica*).

Pheretima imajimai Ishizuka, 1999c: 114-116, figs. 56-65, table 3.

Pheretima confusa Ishizuka, 1999c: 116-119, figs. 66-74, tables 4,6.

Pheretima nipparensis Ishizuka, 1999c: 119-121, figs. 75-84, tables 5,6 [misspelt “*Pheretima nipparaensis*” in Ishizuka (2001: 91)].

Pheretima subrotunda Ishizuka, 2000b: 13-15, figs. 1-7, tab. 1.

Pheretima rufidula Ishizuka, 2000b: 15-16, figs. 8-14, tab. 1 [misspelt “*P. rufidura*” in Ishizuka (2001: 14, 30)].

Pheretima silvestris Ishizuka, 2000b: 18, figs. 23-29, tab. 1 [non *Pheretima silvestris* Michaelsen, 1923 (= *Amyntas silvestris*) nec *Pheretima silvestrii* Cognetti, 1909, now also in *Amyntas*. Under ICZN (1999: Arts. 57.2, 60) this junior primary homonym is permanently invalid but is not replaced as synonyms exist].

Pheretima semilunaris Ishizuka, 2000b: 18-21, figs. 30-36, tab. 1. [misspelt “*Pheretima qasemilunaris*” or “*P. semilnaris*” in Ishizuka (2001: 16, 30, 32)]. For adiverticulate specimens that otherwise appear to comply with *A. corticis*.

Pheretima fulva Ishizuka, 2000b: 21-22, figs. 37-47, table 3.

Pheretima subterranea Ishizuka, 2000b: 22-25, figs. 48-56, table 3.

Pheretima subalpina Ishizuka, 2000b: 25-27, figs. 57-67, tables 2-3 [misspelt “*P. subalpibina*” in Ishizuka (2001: 30)].

Pheretima mutabilis Ishizuka, 2000e: 179-180, figs. 1-9, tab. 1.

Pheretima nubicola Ishizuka, 2000e: 180-182, figs. 10-18, tab. 1.

Pheretima umbrosa Ishizuka, 2000e: 187-189, figs. 43-51 (on page 190), tab. 1; Ishizuka,

2001: 84, fig. 49 [despite a really confused description, the figured genital markings, spermathecae and prostates agree exactly with those figured more than 60 years earlier by Ohfuchi (1937b: 73, 106) in his detailed redescription of *P. divergens* that has, just like *P. umbrosa*, a pair of simple caeca thus invalidating any justification].

*Pheretima invis*a Ishizuka, 2000e: 189-191, figs. 52-59, tab. 1 [this junior primary homonym of *Pheretima invis*a Cognetti, 1913 (= *Metapheretima invis*a) is permanently invalid under ICZN (1999: Arts. 57.2, 60) but is not replaced as synonyms exist for it].

Pheretima nigella Ishizuka *et al.*, 2000b: 185 [name variously spelt and dated as cited in Ishizuka (2001: 12, 13, 90, 102) with the same Japanese vernacular name as “*P. nigella* Ishizuka, 1999” or “*Pheretima neger*a Ishizuka, 2000”, for a single specimen with adiverticulate spermathecae that otherwise complies with *A. corticis*].

Pheretima setosa Ishizuka *et al.*, 2000b: 188. [non *Pheretima setosa* Cognetti, 1908 (= *Metaphire sieboldi* (Horst, 1883))]. [This junior primary homonym is permanently invalid under ICZN (1999: Arts. 57.2; 60) but is not replaced as synonyms exist]. For a single adiverticulate specimen that otherwise appears to comply with *A. corticis*.

Taxonomic notes: Michaelsen (1900: 275) included the prior *Pheretima corticis* (Kinberg, 1867) in possible synonymy under *Pheretima indica* (Horst, 1883) *sensu stricto*, and now it is not certain whether all or any of the *indica* subspecies follow it into synonymy of *corticis* or whether they assume separate specific status. These subspecies are listed by Sims & Easton (1972: 235) as: *Amyntas indicus cameroni* (Stephenson, 1932) from the Malay Peninsula; *Amyntas indicus ceylonicus* (Michaelsen, 1897) from Sri Lanka; and *Amyntas perkinsi* (Beddard, 1896) from Halemanua and Kauai, Hawaii which was included by Michaelsen (1900: 276) as a ‘variety’ of *indica*. Certainly the latter two taxa are not

endemic to their localities.

Often *A. corticis* has been reported under the names of its junior synonyms as *Pheretima diffringens* or *P. peregrina* or, in earlier papers, as *P. heterochaeta*, and sometimes the name is misspelled as "corticus". Sims & Easton (1972: 237) listed *heteropoda* Goto & Hatai, 1898 in *Metaphire* as part of a *bianensis bianensis* (Stephenson, 1931) species-group, but this is almost certainly a mistake as they too will have lacked any type material for reference. Ishizuka *et al.* (2000b: 192) have a species they name "*P. diffrigence*" that is possibly a reference to *P. diffringens*.

Diagnosis: *Amyntas* with four pairs of spermathecal pores ca. 0.3 body circumference apart in furrows 5/6/7/8/9 (the last pair sometimes missing?). Genital markings small paired or variable near spermathecal and male pores, or absent. Intestinal caeca simple with smooth or incised margins, originating near segment 27. Parthenogenetic morphs common (e.g., prostates and/or spermathecal diverticula aborted). Size range given as 45-270 mm (Sims & Gerard, 1985: 128; 1999: 128); cf. 45-170 mm (Gates, 1972: 178), (cf. *Amyntas fuscatus* given as 100-450 mm).

Distribution: According to Beddard (1893), its occurrence is "everywhere, including Europe". This species is the most widely distributed of the allochthonous species of the pheretimoid group, having been recorded from temperate and tropical regions throughout the world. Tropical records are more rare and usually from higher altitudes. The indigenous range of the species is believed to be in east and south-east Asia: Nepal, northern Pakistan and India, Myanmar, and southern China and it is also found in Taiwan, Korea, and Japan.

Remarks: Parthenogenesis is implied by the often reduced, parasitised or incomplete male reproductive and spermathecal organs. Gates (1972: 177-180) mentioned the various parthenogenetic morphs that have been recorded, and although he noted that total loss of

spermathecae and male pores is rare, he reported two specimens in a sample of 60 that lacked the posterior pair of spermathecae, and Gates (1972: 217) further suggested that *Pheretima sheni* Chen, 1935 may be athecal morphs of either *A. robustus* or *A. diffringens* (= *A. corticis*), most likely the latter.

The definition of *Amyntas corticis*, via its synonymous species such as *Pheretima divergens*, now accepts ‘serrate’ intestinal caeca (this character is often not differentiated from the simple kind in earlier descriptions and is perhaps also difficult to differentiate from grades of simple caeca). Small genital markings, where present, sometimes on 17 as well as near, or after, the male pores are also permitted.

While overlooking *Amyntas corticis*, and without obvious justification, Ishizuka (1999a: 58-59) retained *Pheretima divergens* (Michaelsen, 1892) and claimed several “**syn. nov.**”s, i.e., *decempapillata* (sic), *flavescens*, *kamakurensis*, *parvula* (Goto & Hatai), *producta*, and *scholastica*. However, of these, only *Amyntas scholasticus* (Goto & Hatai, 1898) has four pairs of spermathecae (but in 4/5/6/7/8), all the others have three pairs of spermathecae, and most (except for *A. flavescens* and its synonym *P. producta*) were already accepted in *Amyntas gracilis* synonymy. Ishizuka (2001: 101, 103) again listed *Pheretima divergens* (Michaelsen, 1892) but this time had its “**syn. nov.**”s as: *P. decempapillata* (sic), *P. flavescens*, *P. fuscata*, *P. obscura*, *P. producta*, *P. scholastica*, and *P. kamakurensis*, apparently adding *Amyntas fuscatus* (Goto & Hatai, 1898) and *Amyntas obscurus* (Goto & Hatai, 1898) but restoring *Pheretima parvula* (Goto & Hatai, 1898) as a separate species, even though it too has been long considered a synonym of *Amyntas gracilis*. This second listing is as inconsistent as the first and can best be ignored.

Ishizuka (1999c: 119) stated that his *Pheretima confusa* differed substantively from *Pheretima heterochaeta* Michaelsen, 1909 [*sic*, *lapsus* for “(Michaelsen, 1891)”]

only by its serrate intestinal caeca, and Ishizuka (1999c: tab. 6) further shows *P. confusa* sharing with *Pheretima divergens* (= *A. corticis*) both serrate intestinal caeca and presetal markings on 17 but with an extra pair on 18 (and rarely on 19 also). As both prior species have long been synonymised with *Amyntas corticis*, for example *Pheretima heterochaeta* by Gates (1972), and *P. divergens* by Easton (1981; 1982), then *P. confusa* may also belong in synonymy of *Amyntas corticis*. Next, Ishizuka's *Pheretima imajimae* and *Pheretima nipparensis* (which are not to be confused with the prior names *P. ijimae* and *P. nipponica*) do not differ significantly from his *Pheretima confusa* and are therefore similarly synonymised, along with *P. confusa*, in *A. corticis*. All three species are close to Ishizuka's (2000e) *Pheretima umbrosa*, when the errors and legends of the descriptions are corrected, and to his *Pheretima invisa*. Both these degraded morphs, stated to resemble *Pheretima divergens* (Michaelsen, 1892) and *P. heteropoda* (Goto & Hatai, 1898), respectively, therefore join them in synonymy of *A. corticis*.

Ishizuka (2000b; 2000e) has several almost identical and progressively synonymous species, some stated to be similar to *Pheretima divergens* and/or *P. heteropoda*, others that are degraded morphs lacking extensive genital markings, spermathecal diverticula or prostate glands, but all of which most probably belong in synonymy of *Amyntas corticis* (cf. Ishizuka's *Amyntas conformis* and *A. distichus*, and *Pheretima octo* listed below as *incertae sedis*). Those listed here in synonymy are inadequately separated from *A. corticis* and its synonyms, but full resolution requires further research when it may be possible to determine the true affinities of the degraded morphs of this *Amyntas corticis* species-complex.

A brave attempt at resolution was by Ohfuchi (1937b) who detailed variations of *P. heteropoda*, *P. oyamai*, *P. divergens*, and *P. nipponica* but failed neither to clearly separate

nor to merge them. Ishizuka (2001: 103), in defiance of convention, listed the prior *Pheretima nipponica* (Beddard, 1892) as “**syn. n.**” of *P. heteropoda* (Goto & Hatai, 1898). This action can be ignored; moreover, both species have already long been established in the synonymy of *Amyntas corticis*.

Amyntas distichus (Ishizuka, 2000).

Pheretima disticha Ishizuka, 2000e: 185; 2001: 76.

Distribution: Japan.

Diagnosis: Spermathecal pores in 5/6/7/8/9. Male pores superficial. Genital marking closely paired presetal almost mid-ventral in 8-9 and 17-20, at least. Intestinal caeca simple.

Remarks: Approximately 50 *Amyntas* species have spermathecae in 5/6/7/8/9 including the various members of the *Amyntas corticis* species-complex and possibly also *Amyntas carnosus*, yet for some reason Ishizuka compares his species only to *Amyntas hexitus* (Chen, 1946) that has spermathecal pores in 7/8/9.

Amyntas ellipticus (Ishizuka, 1999).

Pheretima elliptica Ishizuka, 1999d: 237.

Distribution: Japan.

Diagnosis: Spermathecal pores in 6/7/8/9. Male pores superficial. Genital marking absent. Intestinal caeca simple.

Remarks: Approximately 50 *Amyntas* species have spermathecae in 6/7/8/9, including *A. flavescens* from Japan; *Amyntas asiaticus* (Michaelsen, 1900) is particularly similar, except for its serrate intestinal caeca.

Amyntas flavescens (Goto & Hatai, 1898)

Perichaeta flavescens Goto & Hatai, 1898: 72. From Tokyo. Types?

(*Perichaeta producta* Goto & Hatai, 1898: 73)? From Tokyo. Types? Genital markings paired anteriorly on 8, 18 and posteriorly on 7, 8 and 18 all in line with the male pores plus a pair posteriorly on 18 median to the male pores. Prostates aborted; spermathecae adiverticulate, i.e. parthenogenetically degraded morph.

(*Pheretima houletti bidenryoana* Ohfuchi, 1956: 169, fig. 15)? [Names sometimes misspelt as “houletti” and “bidenryoana” or “bidenryyoana”].

(*Pheretima leucocirca* : Ohfuchi, 1956: 174 [?non Chen, 1933: 262])? [Misidentification].

(*Pheretima noharuzakiensis* Ohfuchi, 1956: 175, fig. 18)? [Name sometimes misspelt as “noharuzakensis”].

Amyntas (sic) *flavescens* : Beddard 1900a: 628 (syn. *producta*).

Amyntas flavescens : Easton, 1981: 50 (syn. ?*producta*, ?*houletti bidenryoana*, ?*leucocirca* : Ohfuchi, 1956 [?non Chen, 1933], ?*noharuzakiensis*).

Distribution: Japan (including Okinawa).

Diagnosis: Spermathecal pores in 6/7/8/9. Male pores superficial. Genital marking serial, in line with spermathecal pores on 7-9 and in clusters near male pores. Intestinal caeca simple. Spermathecal diverticula and/or prostates sometimes absent (i.e., parthenogenetic morphs).

Remarks: Michaelsen (1900: 264, 314, 317) thought that *Pheretima flavescens* and *P. producta* were possibly junior synonyms (but lacking the anterior spermathecal pores) of his *P. divergens* (= *A. corticis*). Easton (1981) tentatively placed *Pheretima houletti bidenryoanus* (Ohfuchi, 1956) in synonymy of *A. flavescens*. However, Gates (1972: 192) and Sims & Easton (1972: 237, 243) had earlier recognized its specific status separate from

Metaphire houlleti (Perrier, 1872), thus it was assigned as *Amyntas bidenryoanus*. It is provisionally retained in synonymy of *A. flavescens* despite Ishizuka (1999a: 60) inexplicably and erroneously listing the prior *Metaphire houlleti* in synonymy of *Amyntas bidenryoanus*, both of which he reverted to *Pheretima* - actions that can be ignored.

***Amyntas fuscatus* (Goto & Hatai, 1898)**

Perichaeta fuscata Goto & Hatai, 1898: 66. Type locality Kamakura; Reynolds & Cook, 1976: 104 state "Typus perditus", i.e., types lost.

Perichaeta grossa Goto & Hatai, 1898: 75. Type locality Kawaguchi, Yamanashi-ken.

Perichaeta iizukai Goto & Hatai, 1899: 14. Locality in Musashi, Saitama-ken. Types lost (Reynolds & Cook, 1976: 116), but at one time in University of Tokyo (Easton, 1979: 43)

Polypheretima iizukai : Easton, 1979: 43; Easton, 1981: 61.

Pheretima iizukai : Ishizuka, 2001: 90, figs. 1-8 (fig. 2 shows caeca).

?*Perichaeta shimaensis* Goto & Hatai, 1899: 15)? From Shima, Kai Peninsula, Kansai (H. Sakai pers. comm.). [Possibly a valid taxon with GMs paired on 19 posteriorly; cf. Easton (1981) who mistakes location as "Gumma-ken" and placed it in synonymy of *micronarius*]. Types? New material complying with type description found by current author from Mt Fuji, about central within the range of *A. fuscatus*.

Amyntas fuscatus : Sims & Easton (1972: 235, 242).

Metaphire fuscata : Easton, 1981: 57 (syn. ?*grossa*).

Pheretima montana : Ishizuka, 1999c: 103 (non *Pheretima montana* Kinberg, 1867: 102).

[Under ICZN (1999: Art. 57.2) *Pheretima montana* Ishizuka, 1999 is an objectively and permanently invalid junior primary homonym of *Pheretima*

montana Kinberg, 1867, the type species of the genus *Pheretima*. A substitute name is not provided for Ishizuka's taxon as it is considered a synonym (see ICZN, 1999: Art. 60). In some, but not all, distributed reprints of Ishizuka (1999c) the name "*montana*" is crossed out and another name written in in pen. This does not constitute a published nomenclatural act and is not valid under the code (ICZN, 1999: Arts. 8, 9). In a subsequent paper (Ishizuka, 2001: 12, 14, 92) the name "*Pheretima montivaga* Ishizuka, 1999" appears as a *nomen nudum* (under ICZN, 1999: Arts. 13, 16) for this taxon (cf. Ishizuka, 2001: 12, 102 where "*P. montana* Ishizuka, 1999" reappears). Transfer to *Amyntas* in synonymy with *Amyntas fuscatus* further removes this primary homonym from use (see ICZN, 1999: Arts. 23.3.5; 53.3; 60 and the Glossary definition of synonym).

Pheretima atrorubens Ishizuka, 1999c: 105.

Pheretima alpestris Ishizuka, 1999c: 107.

Pheretima dura Ishizuka, 1999c: 105.

Pheretima turgida Ishizuka, 1999c: 110.

Pheretima argentea Ishizuka, 1999c: 112 [misspelt "*argentina*" in Ishizuka, 2001: 101].

?*Pheretima flavida* Ishizuka, 2000b: 16.

?*Pheretima lactea* Ishizuka, 2000b: 28.

?*Pheretima mitakensis* Ishizuka, 2000b: 28.

Distribution: widespread in Japan.

Diagnosis: Large species (c. 100-450 mm). Spermathecal pores in 5/6/7/8/9. Male pores superficial but may be invaginated on preservation to give spurious appearance of small copulatory pouches (debatably intermediate from superficial in some morphs). Genital marking variable: absent, or sometimes median to spermathecal pores post-setally on 5-8,

and usually serial and in line with male pores centred post-setally in some or all of 17 and/or 19-26. Spermathecae with convoluted diverticula (at least in larger specimens), or adiverticulate (in parthenogenetic morphs). Intestinal caeca relatively small, simple with incised margin (at least in larger specimens).

Remarks: The basis of this revision is inspection of newly collected material from the Hachioji/Mt Takao and Mt Fuji regions and a review of the literature by the current author. Although type material is missing, I defer designation of a neotype until fresh material is obtained from vicinity of the Kamakura type-locality. Almost certainly *Perichaeta iizukai* was misdescribed regarding an absence of intestinal caeca, which is why it was erroneously placed in *Polypheretima* (e.g. by Easton, 1981); the demonstrated presence of serrate caeca in specimens that otherwise comply places it in the synonymy of *Perichaeta fuscata* and removes *Polypheretima* from Japanese indigeneity. The only salient difference of Goto & Hatai's *P. iizukai* from their earlier *P. grossa* was the supposed lack of intestinal caeca, but it has recently come to my attention that Ohfuchi (1937: 41) had already determined that both *grossa* and *iizukai* had intestinal caeca:- "*The intestinal coecum is single in both species*". Indeed, Ishizuka (2001: 90) shows caeca in "*Pheretima*" *iizukai* (but he overlooks the prior *P. grossa*).

Difference in distribution of genital markings for the other synonymous species listed above are within permissible limits for normal intraspecific variability. Ishizuka (1999c) described several specimens as new species, inadequately comparing them with *Pheretima grossa* (Goto & Hatai, 1898), which had already been placed in synonymy of *Metaphire fuscata* (Goto & Hatai, 1898) by Easton (1981). However, on an assumption of differences in male pores, Sims & Easton (1972: 242) had placed *P. fuscata* in an *Amyntas diffringens* (= *A. corticis*) species group and *P. grossa* in a *Metaphire malayana*

species-group, both groups with spermathecae in 5/6/7/8/9 and, on recent review, they may actually be closely allied.

Ishizuka's invalid taxon *Pheretima montana* (non Kinberg, 1867) lacks genital markings (parthenogenetic morph?) but otherwise complies with *A. fuscatus*. Ishizuka (2000b) described further sympatric species that lacked the obvious incised caeca; however, Sims & Easton (1972: 264) remarked that these "cannot be regarded as taxonomic characters as they are more fully formed in the larger specimens and their development would appear to be correlated with growth". Thus it is possible that smooth caeca may become more markedly incised in older specimens and that *Pheretima flavida* Ishizuka, 2000 is synonymous with his *Pheretima montana* Ishizuka, 1999, joining it in synonymy of *A. fuscatus*. Similarly, *Pheretima lactea* Ishizuka, 2000 may be a parthenogenetic morph (lacking prostate glands), and *Pheretima mitakensis* Ishizuka, 2000 its more complete form, thus both are either parthenogenetic and/or underdeveloped specimens synonymous with Ishizuka's *Ph. flavida*.

Parthenogenetic morphs that lack spermathecal diverticula and genital markings, yet otherwise comply with the definition of *A. fuscatus*, have also been identified by the current author, supporting these synonymies. Moreover, large species such as *Amyntas fuscatus* probably survive for several seasons, thus it is not unreasonable to expect that older specimens will have increased development of structures such as genital markings and caeca compared to mature yet younger specimens. As noted in the diagnosis above, the male pores of some specimens may appear invaginated on preservation (and Ishizuka's descriptions only report superficial male pores), but it is here proposed to accept that the normal state has superficial male pores, i.e., attributable to *Amyntas* rather than *Metaphire*.

Notwithstanding this interpretation of the taxa, the slight possibility remains that *A.*

fuscatus is part of the *A. corticis* species-complex as described herein, in which case *A. pingi* (Stephenson, 1923) may also be implicated as discussed by Blakemore (2002: 183) but cf. *A. carnosus*.

***Amyntas glabrus* (Gates, 1932)**

Pheretima glabra Gates, 1932: 395; Gates, 1972: 187 (syn. *tenellula*, *vieta*). From Nam Hpen Noi, Yunnan (in China on border with Myanmar). Types missing.

Pheretima tenellula Gates, 1932: 398. From Kwang Yeh, Yunnan and Myanmar. No types. [Misspelt as "tenellulus" in Sims & Easton (1972: 246) who also (1972: 213, 237) have these taxa in an "*Amyntas youngi*-group" erroneously as *A. youngi* (Gates) acutally has two pairs of spermathecae dorsally in segment 6 and in 6/7].

Pheretima vieta Gates, 1936: 462. From Peng Sai, Myanmar. Types none.

(*Pheretima papilio* : Ohfuchi, 1956: 140 [?non Gates, 1930: 316 - misidentification].

Amyntas glabrus : Sims & Easton, 1972: 242; Easton, 1981: 50 (syn. *vieta*, ?*papilio*: Ohfuchi, 1956).

Diagnosis: Size 30-110 mm. Spermathecal pores small, paired and postsetal on 6 (or absent in some morphs). Male pores superficial on 18 within longitudinal seminal grooves in 17-18 or extending further. Genital markings absent. Intestinal caeca, small, simple.

Distribution: Yunnan (China) and Myanmar (Gates, 1972: 188), Japan: Kyushu and Ryukyus (Easton, 1981: 50) also reported from Sichuan and Guizhou Provinces of China (by Zhong *et al.*, 1987).

Remarks: Gates (1972: 187-188) described this species as parthenogenetic with several known morphs. Gates (1972: 205) rejects the identification by Ohfuchi (1956: 140) of Ryukyu specimens with his *Pheretima papilio papilio* Gates, 1930 subspecies, and Easton

(1981) places these misidentified specimens in possible synonymy with *A. glabrus* pending further investigation. Ishizuka (1999a, 2001) appears to have overlooked *A. glabrus* and, for some reason, Ishizuka (1999a: 63, 66) still lists *P. papilio* Gates, 1930 and *P. vieta* Gates, 1936 as valid names with Japanese records.

***Amyntas gracilis* (Kinberg, 1867)**

Nitocris gracilis Kinberg, 1867: 112. Type locality Rio de Janeiro. Types in Stockholm: 1944 (Reynolds & Cook, 1976: 108), immatures (Sims & Easton, 1972: 214).

Perichaeta hawayana Rosa, 1891: 396. From Hawaii. Type in Vienna (Gates, 1972: 189).

Perichaeta bermudensis Beddard, 1892a: 160. Syntypes in British Museum: 1904:10.5.1362-5.

Perichaeta mandhorensis Michaelsen, 1892: 241, figs. 18-19. From Mandhor, Borneo (and Java). Holotype in Zoological Museum, Berlin: 484. [Note: Gates (1972: 217) remarks that the British Museum specimen 1904:10.5.1401 labeled *P. mandhorensis* from West Indies is a misidentification and mislabeling of *Amyntas robustus*].

?*Perichaeta mauritiana* Beddard, 1892a: 170, Pl X, figs. 5-6.

(*Perichaeta kamakurensis* Goto & Hatai, 1898: 68)? From Kamakura and Tokyo. Types? Spermathecae diverticulate opening in 5/6/7/8.

(*Perichaeta parvula* Goto & Hatai, 1898: 68)? [non Ohfuchi, 1956 (= *Metaphire parvula*); nec Ishizuka *et al.*, 2000b (= *Pheretima palarva* Blakemore)]. From Kamakura. Types? Spermathecae adiverticulate opening in 5/6/7/8; prostates aborted; 32 mm.

(*Perichaeta decimpapillata* Goto & Hatai, 1898: 71)? [Name sometimes misspelt as “*decempapillata*” perhaps following Michaelsen’s different subsequent spelling that is incorrect and unjustified under ICZN (1999: Art. 33)]. From Tokyo. Types?

(*Pheretima kagoshimensis* Takahashi, 1932: 343)? [Sometimes misspelt *cagoshimensis*].

Pheretima hawayana : Michaelsen, 1900: 271, 316 [syn. *bermudensis*, ?*mauritiana*]; Gates, 1972: 189, 217 [syn. ?*barbadensis* (part), *mandhorensis*, ?*mauritiana*].

Amyntas gracilis : Sims & Easton, 1972: 235; Easton, 1981: 50 (syn. *hawayana*, ?*kamakurensis*, ?*parvula* Goto & Hatai, *decimpapillata*, ?*carnosa*, ?*kagoshimensis*); Easton, 1982: 728 (syn. *hawayana*); Sims & Gerard, 1985: 130 (syn. *hawayana*).

Pheretima autumnalis Ishizuka, 1999c: 101-103, figs 1-10, Tables 1, 6 [misspelt “*P. autamunalis*” in Ishizuka (2001: 11, 13, 87, 101)].

Taxonomic Note: *Amyntas gracilis* is sometimes still reported under the name of its junior synonym *A. hawayanus* (Rosa, 1891).

Diagnosis: *Amyntas* with three pairs of spermathecal pores, ca. 0.25-0.3 of the body circumference apart in furrows 5/6/7/8. Genital markings near male (and spermathecal) pores. Intestinal caeca simple, (always?) with incised margins. Prostates always present? Size range 56 – 156 mm (cf. *A. papulosus* 45-78 mm).

Distribution: Tropical and warm temperate localities on most continents. Original homeland possibly in China.

Remarks: Stephenson (1923) included quadrithecal morphs in Rosa’s *Pheretima hawayana* with which he further included the possible synonyms of *Perichaeta barbadensis* Beddard, 1892 (?part - specimen “b”), and *Perichaeta pallida* Michaelsen, 1892 (?part or cf. synonymy of *A. morrisi*), but these may actually be referable to the *Amyntas morrisi* group of Sims and Easton (1972). Sims & Easton (1972: 224, 244) have *Perichaeta parvula* Goto & Hatai, 1898 a *species incertae sedis* as it was described as lacking male pores, but Easton (1981: 50) tentatively placed it, along with *Pheretima carnosus* (Goto & Hatai, 1899),

in synonymy of *Amyntas gracilis*. However, it is unlikely that *Perichaeta parvula* is synonymous with *A. gracilis* as Goto & Hatai described it as small, only 32 mm long, therefore it is possibly closer to *A. papulosus*, or else it belongs *incertae sedis* along with the *A. illotus* species-group (cf. *A. assacceus*).

In the current account, *P. carnosus* is removed from synonymy due to its closely paired genital markings, and is restored as *Amyntas carnosus*.

***Amyntas habereri* (Cognetti, 1906)**

Pheretima habereri Cognetti, 1906: 777, figs. 1-4. From Yokohama. Types not known (in Vienna?).

Amyntas habereri : Sims & Easton, 1972: 234; Easton, 1981: 51

Diagnosis: Length ca. 170 mm. Spermathecal pores closely paired in 5/6/7/8/9. Male pores superficial on large porophores on 18. Genital markings small, paired pre- and post-setal on 19 and 20 (united in common longitudinal fields) in line with male pores. Intestinal caeca manicate, each with about 10 diverticula.

Distribution: Japan (Yokohama), recently rediscovered at Hakone (H. Sakai, pers. comm.).

Remarks: Ishizuka (1999b, 2001) appears to have overlooked this species.

***Amyntas hupeiensis* (Michaelsen, 1895)**

Perichaeta hupeiensis Michaelsen, 1895: 35. From Shi-hui-yao near Wuchang in Hupei (= Fuchow) province, China. Types missing.

Amyntas hupeiensis : Michaelsen, 1899: 6. From Central Japan (Nakahama).

Pheretima hupeiensis : Michaelsen, 1900: 273; Chen, 1933: 251, fig. 19; Kobayashi, 1936; 1938: 152; Gates, 1958: 17-20 (he thought American worms in greenhouses, turf

farms, and golf courses may have been introduced from Japan); Gates, 1972: 213.
Amyntas hupeiensis : Sims & Easton, 1972: 237; Easton, 1981: 53 [misspelt “*hupiensis*”];
Blakemore, 2003 (syn. ?*hypogaea*, ?*edoensis* - cf. *A. micronaria*).

Diagnosis: Spermathecal pores paired in 6/7/8/9. Spermathecae originally described with diverticula twice as long as ampullae but they may be longer when fully formed. Male pores superficial on small porophores on 18. Genital markings large paired near line of male pores in 17/18 and 18/19. Intestinal caeca simple. Septa 8/9/10/11 retained. Coils, but is placid, when touched. Emits an odour.

Distribution: China, Japan, Taiwan, Korea; further introduced into North America and, possibly, New Zealand and Christmas Island (Australia). A species widely distributed by transportation from Asia, occurs in Japan from Hokkaido to Okinawa (Easton, 1981).

Remarks: *Amyntas hupeiensis* is distinguished from the similar *Metaphire bahli* and *M. peguana* by its superficial male pores. Gates (1972: 213) says that the Chinese species, *Amyntas hupeiensis* has been mistaken for *Metaphire posthuma* in the past; thus the report by Easton (1981: 53) of *A. hupeiensis* from New Zealand may be questionable.

Previously two Ishizuka taxa: *hypogaea* and *edoensis* were considered possible synonyms, it now seems that they are in the ambit of *Amyntas obscura* (Goto & Hatai, 1898: 70) or, more likely, *A. micronarius* (Goto & Hatai, 1898: 74). Despite the previous rationale for synonymy of these Japanese names, characteristics of *A. hupeiensis* include its characteristic colour, behaviour and odour (as described above and in Blakemore, 2000) and the extended spermathecal diverticula, however these may naturally start from shorter rudiments.

Amyntas japonicus (Horst, 1883)

Megascolex japonicus Horst, 1883: 192. From “Japan”. Types in Leiden: 1809.

Perichaeta japonica : Beddard, 1895:426.

Pheretima japonica : Michaelsen, 1900: 279.

Amyntas japonicus : Sims & Easton, 1972: 237 (*tokioensis* group); Easton, 1981: 54.

Diagnosis: Length 220mm. First dorsal pore 11/12. Spermathecal pores in 6/7/8. Setae 66 per segment. Male pores superficial on segment 18 in J-shaped seminal grooves that extend into 17. Genital markings absent (or not noted). Intestinal caeca not described (possibly simple as no remark comparing to other manicate species described by Horst, 1883: 194).

Distribution: “Japan” (Horst, 1883) collected by von Siebold but possibly from southern region as with other taxa.

Remarks: It appears that Ishizuka (2001) overlooked this species. Not subsequently found although seminal grooves are reported for other Ryukyu species - e.g. *Amyntas glabrus* that is known to have athecal morphs (Gates, 1972: 188), and decaethecal *M. riukiensis*.

Several Korean species have seminal grooves eg. *A. deogyusanensis* Hong & James, 2001 and *A. pagyeiensis* Hong, 2001, and *A. mujuensis* Hong & Kim, 2004 and their intestinal caeca are simple but they appear to differ in other characters.

Amyntas kunigamiensis (Ishizuka & Azama in Ishizuka, Azama and Sasaki, 2000).

Pheretima kunigamiensis Ishizuka *et al.*, 2000a: 92, figs. 12-25, tab. 2.

Note: Authorship cited as in Ishizuka (2001: 101) rather than “Ishizuka *et al.*” as would be recommended by ICZN (1999: Art. 51C).

Diagnosis: Spermathecal pores in 6/7/8/9. Male pores superficial. Genital marking small near spermathecal (and male) pores, or absent. Intestinal caeca simple, incised. Length 120-262 mm.

Distribution: Japan (Okinawa).

Remarks: The position and number of spermathecal pores (and genital markings) is highly confused and somewhat contradictory in the account, figures, and table in Ishizuka *et al.* (2000a), but if we assume they are in 6/7/8/9 then the current specimens are very closely similar to *Amyntas asiaticus* (Michaelsen, 1900), as well as *A. robustus* as discussed below. Approximately 50 other *Amyntas* species have spermathecae in 6/7/8/9 including *Amyntas bidenryoanus* (= *Amyntas flavescens*) also known from Okinawa (cf. *A. yambaruensis*).

Amyntas micronarius (Goto & Hatai, 1898)

[Fig. 3](#) *Amyntas micronarius* (Goto & Hatai, 1898). Sketch of Watarase Tochigi prefecture specimen collected by Takafumi Kamitani April, 2003 from his Control site "R". Kamakura specimens collected by R.J.B., Y.H. and A.R., 12.iv.2004 from Kuzuharagaoka Shrine (built 1300's) along with seven other spp. Ibaraki specimens collected from farms at Ami in 2006.

Perichaeta micronaria Goto & Hatai, 1898: 74. From Tokyo. Types?

Pheretima micronaria : Michaelsen, 1900: 316 (“perhaps belonging in *P. divergens*”);
Ohfuchi, 1937b: 50, fig. 8; Ishizuka, 2001: 79 (segments miscounted).

(*Pheretima yamizoyamensis* Ohfuchi, 1935: 413)? [Name sometimes misspelt “yamijoyamensis” e.g. Reynolds & Cook (1976: 191), and “yamizoyamaensis” by Nakamura (1994: 27)]. From Yamizo-san, on the border of Fukushima, Ibaraki and Tochigi-ken. Types?

Pheretima obtusa Ohfuchi, 1957: 244, fig. 19. From Sonai, Sakishima. Types?

Amyntas micronarius : Sims & Easton, 1972: 235; Easton, 1981: 54
(syn. ?*shimaensis*, ?*yamizoyamensis*, ?*obtusa*).

?*Pheretima hypogaea* Ishizuka, 1999d: 234; Ishizuka, 2001: 70 [misspelt “hypogae” in

Ishizuka, 2001: 11, 101]. **Syn. nov.**

?*Pheretima edoensis* Ishizuka *et al.*, 2000b: 181; Ishizuka, 2001: 76 [variously cited and dated as “Ishizuka, 1999” or “Ishizuka, 2000” in Ishizuka (2001: 11, 54, 76, 101) for a figured specimen that, although misplaced in a section of species having four pairs of spermathecae, has only three pairs and appears to comply with either *A. micronarius* or *A. obscurus*, most likely the former]. **Syn. nov.**

Pheretima hinoharensis Ishizuka, 2000e: 187, figs. 35-42, tab. 1 [misspelt “*P. hinoharaensis*” in Ishizuka (2001: 11, 18, 78, 101)]. From Itsukaichi (not Hinohara?).

Diagnosis: Length ca. 66-180 mm. Spermathecae four pairs (or three pairs if anterior pair reduced or absent), sometimes adiverticulate, with pores in 5/6/7/8/9 (?or 6/7/8/9). Male pores superficial on segment 18. Genital markings paired almost intersegmental and just median to the lines of the male pores in 17/18 and/or 18/19. Intestinal caeca simple.

Distribution: Japan, from Hokkaido to Ryukus.

Remarks: Michaelsen (1900: 316) thought that this taxon, along with eleven other of Goto & Hatai's names, may be closely related to *P. divergens* (= *Amyntas corticis*) whereas Easton (1981) maintained it. However, it is possible that this taxon is closely related to Goto & Hatai's prior *Amyntas obscurus*, despite the extra pair of spermathecae. Ishizuka's *P. hinoharaensis* is synonymous (previously I had it in *A. corticis*) and, moreover, Ishizuka's *Pheretima hypogaea* and *Pheretima edoensis* (that I previously placed provisionally in *A. hupeiensis*) with three pairs of spermathecae, and *P. tamaensis* with two (adiverticulate) pairs, may also be parthenogenetically degraded morphs belonging to such a group. On the other hand, *Pheretima shimaensis* - considered a possible synonym by Easton (1981: 54), from its description and new material, is apparently separate or closer to *Amyntas fuscatus*.

Nothing in Ohfuchi's description of *obtusa* differs from *micronarius*, apart from "the presence of the diverticulum".

Ibaraki specimens agree with the above description, lacking the extra pair of spermathecae in 5/6 and with spermathecae adiverticulate or just with stalks.

Although a specimen from Watarase or Kamakura could be made a neotype, it would be better to get topotypic samples from "Tokyo", possibly from near the site of the "First High School" in Shibuya where Goto & Hatai were based (cf. Ishizuka's samples).

Amyntas minimus (Horst, 1893)

Perichaeta minima Horst, 1893: 66, fig. 27. Type locality Tjibodas, Java. Type in Leiden: 1836.

Perichaeta pusilla Ude, 1893: 63 [non *Pheretima pusilla* Ohfuchi, 1956 (= *Amyntas assacceus*)]. [Taxonomic Note: Easton (1979: 119) states that *minimus* (Horst, 1893) has priority over *pusilla* Ude, 1893].

Pheretima enchytraeoides Michaelsen, 1916: 33. Type locality in Queensland.

Pheretima zoysiae Chen, 1933: 288, fig. 27. Type locality Chekiang. Types in Nanking (Ann. 570) or reported in Smithsonian.

?*Pheretima fungina* Chen, 1938: 389.

?*Pheretima muta* Chen, 1938: 391.

Pheretima ishikawai Ohfuchi, 1941: 248.

Pheretima humilis Gates, 1942: 120. Type locality, "Earth in large flower pots on west veranda of faculty house", Judson College, Rangoon, Myanmar. "The type locality and types destroyed during World War II".

Pheretima minima : Gates, 1961: 298 (syn. *pusilla* Ude, *enchytraeoides*); Gates, 1972: 201

(syn. *humilis*, ?*zoysiae*, ?*fungina*, ?*muta*, *ishikawai*).

Amyntas minimus : Sims & Easton, 1972: 236; Easton, 1979:119 (syn. *pusilla* Ude, *enchytraeoides*); Easton, 1981: 55 (syn. *zoysiae*, *ishikawai*); Easton, 1982: 728 (syn. *enchytraeoides*, *pusilla* Ude); Easton, 1984: 118.

Diagnosis: Spermathecal pores in 5/6 only, or absent. Male pores superficial on segment 18. Genital markings small on pre- and postclitellar segments, or absent. Intestinal caeca simple. Size 16-60 mm.

Distribution: Widespread species by introduction around the world, originally from Asia.

Remarks: A detailed description may be found in Blakemore (2002). Gates (1972: 202) presumed that parthenogenesis occurs in morphs referred to this taxon, and it is probable that *Pheretima oyuensis* (*species incertae sedis*) is an AR or ARZ morph. Ishizuka (1999a; 2001) appears to have overlooked *A. minimus* and has ignored the nomenclatural conflicts in some its synonyms which he seems to still maintain.

Amyntas morrisi (Beddard, 1892)

Perichaeta morrisi Beddard, 1892a: 166. Type locality Kew Gardens in soil from Penang and/or Hong Kong. Types in British Museum according to Gates (1972) but not listed in Reynolds & Cook (1976).

Perichaeta barbadensis Beddard, 1892a (July): 167 (?parts “a” and “c” cf. *A. gracilis*).

?*Perichaeta pallida* Michaelsen, 1892 (Sept.): 227 (cf. *A. gracilis*). From Porto Alegre.

Syntypes in Zoological Museum, Berlin: 441 (missing after loan to Turin in 1893).

Pheretima barbadensis : Michaelsen, 1900: 254; 316 (syn. *pallida* Michaelsen, 1892, *amazonica* Rosa, 1894: 14, *sanctijacobi* Beddard, 1895: 61, *cupulifera* Fedarb,

1898: 445). [It is not certain that all of these synonyms follow *barbadensis* into synonymy of *morrisi* – see remarks below].

Pheretima morrisoni : Michaelsen, 1900: 287; Gates, 1972: 202 (syn. *hawayana lineata*).

Pheretima hawayana lineata Gates, 1926: 154.

Pheretima exiloides : Ohfuchi, 1956: 142 [non Chen, 1936]. [Misidentification].

Pheretima elongata : Ohfuchi, 1956: 148 [non Perrier, 1872: 124 (= *Polypheretima elongata*)]. [Misidentification].

Amyntas morrisoni : Sims & Easton, 1972: 236, figs. 1A, 1H; Easton, 1981: 55 (syn. *exiloides*: Ohfuchi, 1956, *elongata*: Ohfuchi, 1956); Easton, 1982: 729, fig. 4c; Sims & Gerard, 1985: 132, fig. 47a (syn. *barbadensis*, *mauritiana*).

Diagnosis: Spermathecal pores in 5/6/7. Male pores superficial on segment 18. Genital markings small on pre- and postclitellar segments, single median in 6-8. Intestinal caeca incised.

Distribution: Widespread around the world by introduction. In Japan, known from Kanagawa (O-shima) to Okinawa.

Remarks: Gates (1972: 203) presumed this species to be biparental (i.e., not parthenogenetic). Sims & Gerard (1985; 1999) include both Beddard's *barbadensis* and *mauritiana* in *A. morrisoni*. Beddard's *barbadensis* comprised more than one species (and it is probable that his specimen "b" with three pairs of spermathecae is actually *A. gracilis*), but his specimens "a" (the primary type?) and especially "c" are closer to the current species. According to Michaelsen (1900: 254), *A. barbadensis* defined with spermathecae in 5/6/7 or seldom in 5/6/7/8 has several junior synonyms (listed under this entry in the synonymy above), but the possibility that some of these are synonyms of *A. gracilis* requires further research. It is more likely that *A. mauritiana* is a variation of *A. gracilis*, lacking the anterior

pair of spermathecae, as was suggested by Michaelsen (1900: 316), Gates (1972: 217), and Blakemore (2002: 177). Ohfuchi (1956) misidentified *P. morrisi* as both *Pheretima exiloides* and as *Pheretima elongata*, according to Gates (1972: 182) and Easton (1981: 55). Through inadequate survey of the literature and lack of understanding of taxonomic principles, Ishizuka (1999a: 63; 2001: 101) proposed the invalid and incorrect synonymy of the prior *Pheretima elongata* (Perrier, 1872) in *Pheretima morrisi* (Beddard, 1892). This action can be ignored (see *Polypheretima elongata* below).

Amyntas obscurus (Goto & Hatai, 1898)

Perichaeta obscura Goto & Hatai, 1898: 70 [non *Perichaeta obscura* Spencer, 1893: 3 (= *Diporochaeta obscura*). Note: according to ICZN (1999: Art. 23.9.5) the junior primary homonymy by Goto & Hatai (1898) of *Perichaeta obscura* Spencer, 1893, as noted in Reynolds & Cook (1969: 146) and Blakemore (2003), is not replaced and prevailing usage is maintained as the two taxa were “not considered congeneric after 1899”, e.g. Michaelsen (1900: 202, 316) at least had them in separate genera]. From Kamakura. Types?

Pheretima obscura : Michaelsen, 1900: 316 (“*perhaps belongs in P. divergens*”); Ishizuka, 1999a: 63; 2001: 103.

Amyntas obscurus : Sims & Easton, 1972: 237; Easton, 1981: 56.

Diagnosis: Spermathecal pores postsetal on 6, 7, and 8 (or more likely as originally described just in front of 6/7/8/9). Male pores superficial on segment 18. Genital markings anterior on 18 and posterior on 18 and 19, median to the line of the male pores. Intestinal caeca simple. Spermathecae with straight, digitiform diverticula.

Distribution: Japan, known only from Kamakura, but see *A. micronarius*.

Remarks: Michaelsen (1900) thought this species was possibly synonymous with *P. divergens* (= *Amyntas corticis*) despite its having only three pairs of spermathecae. Sims & Easton (1972: 237) placed *A. obscurus* in an *A. sieboldi* species-group that has spermathecal pores in 6/7/8/9, whereas Easton (1981) accepted the pores were on 6, 7 and 8. As noted under *A. micronarius* above, this species may have several parthenogenetically degraded morphs. Possibly it is a morph of *A. micronarius* with one fewer pairs of spermathecae.

Goto & Hatai's descriptions were notoriously inaccurate and it is just as possible that this *A. obscurus* is the same as their later *P. decimpapillata* or *P. flavescens*, or that all actually have non-superficial male pores and thus qualify for *Metaphire*.

***Amyntas papulosus* (Rosa, 1896)**

Perichaeta papulosa Rosa, 1896: 525. Type locality Balighe, Sumatra. Types in Genoa Museum : 44034; other material in British Museum (Sims & Easton, 1972:181).

Pheretima papulosa var. *sauteri* Michaelsen, 1922: 26. Type locality Dorf Kosempo, Taiwan. Types in Leiden: 1814.

Pheretima composita Gates, 1932: 430. Type locality Kengtung, Myanmar. Types none.

Pheretima rockefelleri Chen, 1933: 238. Type locality Linhai, Chekiang, China. Types in U.S. National Museum: 20176.

Pheretima papulosa : Michaelsen, 1900: 291; Beddard, 1900a: 644; 1900b: 892; Gates, 1972: 206 (syn. *papulosa sauteri*, *composita*, *?rockefelleri*).

Amyntas papulosus : Easton, 1981: 56 (syn. *papulosa sauteri*, *rockefelleri*).

Pheretima hsinpuensis Kuo, 1995. From Taiwan. [Name originally misspelt "hsinpuesis"; corrected and synonymized with *A. rockefelleri* (Chen, 1933) by Shen, *et al.* (2003a) and independently by Blakemore (2003, addenda)].

Diagnosis: Spermathecal pores in 5/6/7/8. Male pores superficial on segment 18. Genital markings small pre- and postsetal discs in transverse rows on 6,7-9 and 17-19. Intestinal caeca simple. Size range 45-78 mm (*rockefelleri* 85-130 mm).

Distribution: China, Taiwan, and south-east Asia; recorded from Kyushu and the adjacent Yaku-Shima (Kobayashi, 1941), but reports from the Riukyus by Ohfuchi (1956) are most likely mistakes according to Gates (1972: 207) (cf. Easton, 1981: 56).

Remarks: This species may be easily confused with *A. gracilis*, differing only in its genital markings, and possibly its slightly smaller size. Gates (1972: 207) dismisses Ohfuchi's (1956: 164) report from the Ryukyu Islands of *P. papulosa* var. "*sauteria*" [sic]. Inexplicably, Ishizuka (1999a: 64, 65) resurrected both "*Pheretima papulosa* (ROSA, 1896) var. *sauteria* OHFUCHI, 1956" (*sic*, *lapsus* for *Pheretima papulosa sauteri* Michaelsen, 1922) and "*Pheretima rokefelleri* CHEN, 1933" (*sic*, misspelling of *rockefelleri*), although Gates's synonymies of both taxa in *A. papulosus* were accepted by Easton (1981), Shih *et al.* (1999: 436), and Tsai *et al.* (2000: 286). The *sauteri* variety was originally distinguished by location of caeca from 29 extending forward to 26 in a single specimen that may have been abnormal (Gates, 1972: 207). Gates (1972: 207) also thought that the parthenogenetic *rockefelleri* morph (lacking prostates and sometimes with defective spermathecae) was only distinguished by quantitative differences. More recently Shen *et al.* (2003a) disputed their earlier inclusion of *A. rockefelleri* in *A. papulosus* and retained both taxa but added *A. hsingpuensis* to synonymy of the former (as per synonymy by Blakemore, 2003 addenda).

Amyntas phaselus (Hatai, 1930)

Pheretima phaselus [sic] Hatai, 1930b: 659, fig. 7. From Sendai, Aomori, Hokkaido, Shikoku. Types? (Described as "nearly white all over" and as "slugish, does not make typical jump but instead secretes a mucous juice copiously" - possibly due to parasitism).

(*Pheretima maculosus* [sic] Hatai, 1930b: 661)? [Non *Pheretima maculosa* Gates, 1933 (= *Amyntas malacus* (Gates, 1936) nom. nov. pro *Pheretima maculosa* Gates, 1933 as confirmed by Sims & Easton (1972: 237) and Gates (1972: 199), cf. Nakamura (1999b: 2) who proposed the unnecessary replacement name "*Pheretima medimaculosa*" for Gates's *P. maculosa*)]. [Note: Sims & Easton (1972: 237) mistakenly cite *Planapheretima maculata* (Ude, 1925) as a further homonym, cf. Sims & Easton (1972: 243) where this specific name is correctly cited]. From Sendai, Kominato, Yokohama village, Moura, Sapporo and Yunoshima Island, Aomori-ken. Types? (Described as "uniform light grayish" or with "transparent body wall" but also "spotted appearance").

(*Pheretima kamitai* Kobayashi, 1934: 5, figs. 4-6)? From Keijo, Korea. Two specimens.

Pheretima serrata Kobayashi, 1936: 165. From Koryo, 30 km from Kijo, Korea. About 21 specimens. (Placed in synonymy of *kamitai* by Kobayashi, 1938: 146, fig. 11).

Amyntas serratus; Sims & Easton, 1972: 245.

Pheretima phaselus typica (sic); Kobayashi, 1938: 410. From Hakodate.

(*Pheretima phaselus tamurai* Kobayashi, 1938: 411)? Said to differ only by its male pore aspects that, despite being in L-shaped grooves, are stated to be "without any porophore-like elevation". From Hakodate. Types?

Diagnosis: Spermathecal pores in 5/6/7/8. Male pores superficial within bean-shaped

pads bearing small, shallow longitudinal slit (or "L" shaped grooves in *tamura*) that possibly function as seminal grooves. Genital markings absent. Intestinal caeca simple with incised margins. Spermathecae with long diverticula. Originally described as nearly white all over the body except for a dark clitellum; it is sluggish and does not jump like most other worms. Male pores were said to be in large kidney bean shaped patches with longitudinal slits in centres.

Distribution: Japan, Korea.

Remarks: Easton (1981: 48) tentatively put *Amyntas phaselus* (Hatai, 1930), *Metaphire maculosa* (Hatai, 1930) [genus designation from Sims & Easton (1972: 239) probably wrong and should be in *Amyntas*], *Amyntas kamitai* (Kobayashi, 1934) and *Amyntas phaselus tamurai* (Kobayashi, 1938) in synonymy of "*Amyntas acinctus*" that is now presumed to actually be in *Metaphire*. In addition, *Amyntas serratus* (Kobayashi, 1936) was included because Kobayashi (1938: 146) had placed it in synonymy of his *A. kamitai* (Kobayashi, 1934). Ishizuka (1999a: 56, 64) restored some of these subspecies as (illegitimate) infrasubspecific varieties under "*Pheretima phaselus* HATAI, 1930" [sic] while also placing *Metaphire yezoensis* (Kobayashi, 1938) from Hokkaido in synonymy of '*Pheretima acincta*' as was suggested by Yamaguchi (1962) and Kamihira (1973), although Easton (1981) had maintained it separately as *Metaphire yezoensis*.

Earlier, Sims & Easton (1972: 236, 245) had listed *Amyntas phaselus phaselus* and *Amyntas phaselus tamurai* subspecies, the former miscited by Ishizuka (1999a: 64) as "*Pheretima phaselus* HATAI 1930 var. *typica* KOBAYASHI, 1938". But Sims & Easton (1972: 239) placed *Pheretima maculosa* Hatai, 1930 and *Pheretima yezoensis* Kobayashi, 1938 in a *Metaphire merabahensis*-group, whereas Ishizuka (2001: 86) figured "*Pheretima maculosa* Ishizuka, 2000" (*lapsus* for Hatai's species of 1930, cf.

Ishizuka 2001:12,102) with superficial male pores qualifying for inclusion, as here, in *Amyntas* (however his figure has the segments miscounted and it is also possible that the specimen is the same as *A. stipatus* or some other species such as *Amyntas gracilis*). Hong *et al.* (2001: 264) describe a superficially and morphologically similar Korean species, *Amyntas minjae* Hong, 2001 that they compare with *A. phaselus* and *A. kamitai*. Moreover, *A. assacceus* as described under *species incertae sedis* herein is also similar to these taxa.

Amyntas quintanus (Ishizuka, 1999).

Pheretima quintana Ishizuka, 1999d: 239.

Diagnosis: Spermathecal pores in 4/5/6/7/8/9. Male pores superficial. Genital marking near male pores on 18. Intestinal caeca simple.

Distribution: Japan.

Remarks: Approximately 14 *Amyntas* species have spermathecae in 4/5/6/7/8/9, possibly including *Amyntas scholasticus* from Japan, and the two similar *A. albobrunneus* and *A. orientalis*, these latter both by Beddard (1912). It is not clear why Ishizuka chose only to differentiate this species from *A. micronarius* that has spermathecal pores in 5/6/7/8/9 and genital markings that are larger and closer to intersegments 17/18 and 18/19, and which itself may be a synonym of *A. obscurus*.

Amyntas robustus (Perrier, 1872)

Perichaeta cingulata (part) : Vaillant, 1867:234 (err. non Schmarda, 1861).

Perichaeta robusta Perrier, 1872: 112. Locality Mauritius or Manila? Types in Paris.

Perichaeta masatacae Beddard, 1892b: 761. [Note: Sims & Easton (1972: 181; 244), Reynolds & Cook (1976: 134), and Easton (1981: 56) misspell Beddard's species "mastakae", while Michaelsen (1900: 282) has it correctly, as here, as *P. masatacae* named after donator Mr Masataka Rokugo]. Spermathecal pores and genital markings (two on each side with glands internally) on 8 and 9; spermathecae "very small"; the "usual pair of caeca are in 27". From "Japan". Two syntypes in British Museum, 1904:10:5:91-2 or 1904:10.5.912-13.

Pheretima masatacae . - Michaelsen, 1900: 282; Kobayashi, 1937: 337, fig. 2; Ohfuchi, 1938c: 62, figs 6-7.

Megascolex robustus. - Vaillant, 1889: 76 [this name miscited by Reynolds & Cook (1976: 164) as a separate species].

Perichaeta campestris Goto & Hatai, 1898: 67 [non *Pheretima campestris* Lee, 1952: 39 which Lee (1959: 327) placed in synonymy of *Amyntas peregrinus* (= *Amyntas corticis*); Nakamura (1999b: 2) proposed a replacement name "*Pheretima medicampestris*" for Lee's *campestris*, but under ICZN (1999: Art. 60) this secondary junior homonymy replacement name is unnecessary since available and valid synonyms exist]. Spermathecal pores in 7/8/9 and genital markings on 7 and 8. From Kamakura. Types not known.

?*Pheretima lauta* Ude, 1905: 405 (429?). Types in Hamburg Museum [syn. *Pheretima siemsseni* Michaelsen, 1931: 17, *Pheretima fokiensis* Michaelsen, 1931: 19 - these synonyms from Chen (1933: 282)].

?*Pheretima zavattarii* Cognetti, 1909: 1. From Madagascar.

Pheretima ornata Gates, 1927: 20. From Laisho. Types in Indian and U.S. National Museums.

Pheretima corrugata Chen, 1931: 131. Types in Smithsonian Institution.

?*Pheretima sheni* Chen, 1935: 38 [cf. *A. corticis*, *A. illotus*]. From Hong Kong. Types in U.S. National Museum: 20181 (or Fan Biological Institute, China?).

Pheretima robusta: Michaelsen, 1900: 299; Chen, 1936: 271 (syn. *siemssen* (part), *fokiensis*, *lauta*, *loehri*, *corrugata*; non *P. corrugata kulingiana* nec *P. aspergillum*); Ljungström, 1971: 27 (syn. *campestris*, *corrugata*, *lauta*, *masatacae*); Gates, 1972: 216 [syn. *ornata*, ?*zavattarii* (sic lapsus pro *zavattarii*), ??*sheni*].

Amyntas robustus : Sims & Easton, 1972: 234; Easton, 1981: 56 [syn. *mastakae* (sic lapsus pro *masatacae*), *campestris* Goto & Hatai, 1898 (non Lee, 1952), *lauta*, *corrugata*].

Diagnosis: Spermathecal pores 0.5 body circumference apart in (6/)/7/8/9. Male pores superficial on segment 18. Genital markings small, paired on 7, 8, 9 and (larger on) 18, at least; spermathecal and male pores on small circular discs. Intestinal caeca simple but incised. Size 33-180 by 2-9 mm, but usually >85 mm (Gates, 1972).

Distribution: Widespread species by introduction, found in China (homeland?), Taiwan, Korea (including Quelpart Island), Japan, Okinawa, India, (Philippines, West Indies, Madagascar, Mauritius?).

Remarks: Easton (1981) considered *P. campestris* Goto & Hatai in synonymy but this must be questioned as the spermathecal pores are less than 0.5 body circumference apart - ca. 0.3 according to the original description - and the markings on (7, 8 and 17-19) are all postsetal. Conversely, *P. obscura* Goto & Hatai, 1898: 70 may be in synonymy as it differs only in an extra pair of spermathecal pores in 6/7. Easton (1981) had *Amyntas lautus* (Ude, 1905) as a synonym of *A. robustus*, but this requires confirmation as Tsai *et al.* (2000: 286) disagree, based on inspection of (all?) Taiwanese specimens. On the other

hand, Chen (1933: 282) thought *Ph. (Ph.) seimsseni* Michaelsen 1931:17 and *Ph. (Ph.) fokiensis* Michaelsen, 1931: 19 were synonymous with *P. lauta* Ude; and later Chen (1946: 136) thought his *P. corrugata* was synonymous with *P. robusta*, but he specifically excluded his *P. corrugata kulingensis* Chen, 1933: 278 subspecies.

Ljungström (1971) revised this taxon and placed *P. masatacae* in synonymy. This latter was redescribed and figured by Kobayashi (1937: 337, fig. 2) who, like Beddard, found Quelpart Island specimens that lacked prostatic glands (i.e., parthenogenetic morphs); he also noted its closeness to *P. ultoria* Chen, 1935 from Hong Kong. *P. masatacae* was also redescribed by Ohfuchi (1938c: 62, figs 6-7). Recently, *A. masatacae* was again claimed from Taiwan by Chuang & Chen (2002).

Gates (1972: 216-218) said *A. robustus* was a parthenogenetic species complex that possibly involved athecal *Amyntas sheni* (Chen, 1935) and morphs with various spermathecal deformities; and he thought it especially similar to, and possibly a junior synonym of, *Amyntas aspergillum* (Perrier, 1872:118) which is known from China (Fuchow, Amoy, and Kowloon) as well as Taiwan (Taipei). However, probably *A. aspergillum* is separate as, although it has spermathecae in 7/8/9, it tends to a larger size of 115-375 mm, and its junior synonym is the Taiwanese *Perichaeta takatorii* Goto & Hatai, 1898:76 according to Michaelsen (1900: 318) and Shih *et al.* (1999: 436).

In the current studies a Japanese specimen was identified that, apart from its spermathecae in 6/7/8/9 (cf. *P. obscura* Goto & Hatai, 1898: 70), was identical with sympatric specimens attributable to *A. robustus* (pers. obs.), which is why this option is given in the above diagnosis. We know that parthenogenetic complexes often vary in spermathecal details. Moreover, two taxa albeit with spermathecae in 6/7/8/9 recently described from Okinawa are similar on most points to *Amyntas robustus* from which

they were inadequately differentiated (see *A. kunigamiensis* and *A. yambaruensis* both from Ishizuka *et al.*, 2000a).

Amyntas scholasticus (Goto & Hatai, 1898)

Perichaeta scholastica Goto & Hatai, 1889: 70. From Tokyo. Types?

Pheretima scholastica: Michaelsen, 1900: 317 [?syn. *divergens* (= *A. corticis*)].

Amyntas scholasticus : Easton, 1981: 57.

Diagnosis: Spermathecal pores in 4/5/6/7/8 (not 4/5/6/7/8/9). Male pores superficial on segment 18. Genital markings absent. Intestinal caeca simple. Spermathecae partly with and partly without diverticula. Prostatic gland present, duct aborted (always?).

Distribution: Japan (Tokyo).

Remarks: Michaelsen (1900) and Easton (1981) have this species with four pairs of spermathecae in 4/5/6/7/8 as originally described, but Sims & Easton (1972: 236; 268) mistakenly place it in an *Amyntas hexathecus*-group with five pairs while noting that *A. hexathecatus* (Benham, 1896) actually possesses only five pairs of spermathecae [cf. Nakamura (1999b) who still claims six pairs]. Ishizuka (1999a: 59), perhaps following the suggestion of Michaelsen (1900), placed this species in synonymy of “*Pheretima divergens*” which is now in synonymy of *Amyntas corticis* that more often has four pairs of spermathecae in 5/6/7/8/9. Lack of genital markings, spermathecal diverticula and prostatic ducts mark this entity as a pathenogenetically degraded morph and it is yet possible that other taxa, such as Ishizuka’s *A. quintana* (albeit with a greater compliment of spermathecae), are in its synonymy.

Amyntas yambaruensis (Ishizuka & Azama in Ishizuka, Azama and Sasaki, 2000).

Pheretima yambaruensis Ishizuka *et al.*, 2000a: 90.

Note: Authorship cited as in Ishizuka (2001: 101) and as recommended by ICZN (1999 Art. 50A, 51D) rather than “Ishizuka *et al.*” as would be recommended by ICZN (1999: Art. 51C).

Diagnosis: Spermathecal pores in 6/7/8/9. Male pores superficial. Genital marking small near spermathecal and male pores. Intestinal caeca simple, incised.

Distribution: Japan (Okinawa).

Remarks: Approximately 50 *Amyntas* species have spermathecae in 6/7/8/9 [including *Amyntas bidenryoanus* (= *Amyntas flavescens*) that is also known from Okinawa]. The current specimens have not been adequately differentiated from, and thus may well be synonymous to, *Amyntas robustus*.

Genus *Duplodicrodrilus* Blakemore, 2007

Type-species *Megascolex schmardae* Horst, 1883: 194 from “Japan”. [Non *Megascolex schmardae* Michaelsen, 1897: 208 from “foot of Adams Peak”, Sri Lanka for which replacement is not automatically required and prevailing usage is maintained (under ICZN, 1999: Art. 23.9.5) since these taxa have not been considered congeneric after 1899, e.g. Michaelsen (1900) held them in separate genera].

Diagnosis Male pores within copulatory pouches on segment 18, eversible as large inflatable and doubled intromittant organs or pseudo-penes (Fig. 6). Genital markings lacking. Intestinal caeca manicate or complex, paired in segment 27 (Fig. 7). Holandric. Spermathecal pores paired in 7/8/9.

Included species *Duplodicrodrilus schmardae schmardae* (Horst, 1883) (type)

[syns. ?*Perichaeta sumatrana*: Beddard, 1892a:155, Pl IX, fig. 4, (non *Megascolex sumatranus* Horst, 1883); *Perichaeta trityphla* Beddard, 1896: 205 from Barbados, types BMNH:1904.10.5.169; *Pheretima kikuchii* Hatai & Ohfuchi, 1936: 767 from Japan]; *D. schmardae macrochaeta* (Michaelsen, 1899: 235 is listed as a subspecies by Sims & Easton (1972: 239) which, as described by Michaelsen (1900: 302), is from Japan and “Tiensin, China” but it is not certain that its variations are outside of normal intraspecific variability and therefore this name may warrant merger with the nominal subspecies.

Etymology for the doubled, eversible copulatory organs resembling “air-bags” in this worm (gender masculine).

Distribution Oriental (Japan, China), the nominal type widespread by transportation.

Remarks Male organs of *Duplodicrodrilus schmardae* differentiate it from other comparable pheretimoid genera: male pores are superficial in *Amyntas* Kinberg, 1867: 97 (Fig. 1) or non-superficial in *Pheretima* Kinberg, 1867: 102 (Fig. 2) and *Metaphire* Sims & Easton, 1972 (Figs. 3-5). The newly proposed genus is most derived in its complex eversible male organs (Fig. 6), combined with its complex intestinal caeca (Fig. 7) that is perhaps less taxonomically important. The elaborate eversible male organs of *Duplodicrodrilus*, used for mutual charging of spermathecae, differ from those found in *Metaphire* and, moreover, lack of spermathecal nephridia differentiate both from *Pheretima s. stricto*.

Several other taxa described with large and eversible male pores, possibly also forming doubled intromittent organs or pseudo-penes, that may qualify them for inclusion with *D. schmardae* in *Duplodicrodrilus*. Likely candidates species are:

- *Metaphire bipora* (Beddard, 1900: 908) plus its synonyms from “Malay Peninsula” (including Singapore), Myanmar, and Thailand that has one or two

pairs of genital markings (in 19 or 19 and 20) themselves resembling copulatory pouches, four pairs of spermathecae in 5/6/7/8/9 and simple intestinal caeca;

- and *M. virgo* (Beddard, 1900: 895) from Thailand, Malaysia and Myanmar with spermathecae in 6/7/8/9 that also has simple intestinal caeca.

Inclusion of these taxa would require expanding the generic definition to include their characteristics (e.g. simple caeca, extra spermathecal pores and genital markings) as well as genus distribution.

Less likely candidates also described with large eversible intromittent organs are:

- *M. kengtungensis* (Gates, 1931) from Myanmar and Laos with spermathecae in 7/8/9 that has glands within its copulatory pouches “*perhaps somewhat as in P. schmardae*”;
- *M. quadrigemina* (Gates, 1932) from Myanmar with spermathecae in 6/7/8/9;
- *M. brevipenis* (Qiu & Wen, 1988) from Guizhou, China with spermathecal pores in 7/8/9 and simple caeca;
- and, questionably, *M. quelparta* (Kobayashi, 1937) from Cheju Island, South Korea with spermathecae in 6/7/8/9 plus its possible synonym *M. sanseiana* (Ohfuchi, 1951) from China.

Another possible member of this group would be Gates’ (1972: 199) rather contradictory concept of *Metaphire malayana* (Beddard, 1900) [cf. *M. bipora* and *Pheretima (Pheretima) darnleiensis* as redescribed by Blakemore (2002; 2006; 2007)].

Determination of membership in *Duplodicrodrilus* requires inspection of all the taxa listed above (plus their synonyms) probably including DNA ‘fingerprinting’,

preferably of (neo)types, and their comparison with the type, but this work is beyond the resources of the current study and is deferred.

***Duplodicrodrilus schmardae schmardae* (Horst, 1883)**

[Fig 4.1](#) *Duplodicrodrilus schmardae*, eversible male pores and intromittent organs (after Hatai & Ohfuchi, 1936, figs. 4, and 8 for their *P. kikuchii* synonym).

[Fig 4.2](#) *D. schmardae*, manicate (or multiple) intestinal caeca (after Hatai & Ohfuchi, 1936, fig. 9 for their *P. kikuchii* synonym).

Megascolex schmardae Horst, 1883: 194. [Non *Megascolex schmardae* Michaelsen, 1897: 208 from “foot of Adams Peak”, Sri Lanka. Since these taxa have not been considered congeneric after 1899, e.g. Michaelsen (1900) had them in separate genera, a replacement name is not automatically required and prevailing usage is maintained (ICZN, 1999: Art. 23.9.5)]. From “Japan”. Syntypes in Leiden: 1818 (inspected by Sims & Easton, 1972: 181) and (erroneously?) reported as in Vienna: 3970 by Reynolds & Cook (1976).

?*Perichaeta sumatrana*: Beddard, 1892a:155, Pl IX, fig. 4, (non *Megascolex sumatranus* Horst, 1883).

Perichaeta trityphla Beddard, 1896: 205. From Barbados. Types BMNH:1904.10.5.169. [Name misspelt “trityphia” e.g. Sims & Easton, 1972: 246].

Amyntas schmardae [sic]: Michaelsen, 1899: 13; Beddard 1900a: 619 (syn. *trityphla*, *vesiculata*).

Pheretima schmardae: Michaelsen, 1900: 302 (syn. *trityphla*).

Pheretima kikuchii Hatai & Ohfuchi, 1936: 767.

Metaphire schmardae schmardae: Sims & Easton, 1972: 239 (*schmardae*-group);
Blakemore, 2003.

Metaphire schmardae: Easton, 1981: 58 (syn. *kikuchii*); Sims & Gerard, 1985: 132, fig. 47e
(syn. *sumatrana*: Beddard, non Horst, 1883) [as Beddard's (1892) account of
sumatrana from Kew Gardens did not mention that the intestinal caeca were
manicate, therefore it is more likely that these specimens were of *Metaphire*
californica or possibly *M. javanica* - especially since Sims & Easton (1972:239)
placed it in the *javanica*-group with simple intestinal caeca].).

Duplodicrodrius schmardae; Blakemore, 2007.

Note: as remarked on above, Sri Lankan *Megascolex schmardae* Michaelsen, 1897 is not
the same species as *Megascolex schmardae* Horst, 1883 (= *Metaphire schmardae*).

Dignosis: Spermathecal pores paired, c. 0.5 circumference apart in furrows 7/8/9. Male
pores within copulatory pouches on segment 18. Genital markings lacking. Intestinal caeca
manicate in segment 27.

Distribution: Japan (type locality); Hawaii; Antilles; Barbados; Sao Paulo, Brazil (Righi,
1980 plus other Brazilian reports); China; Taiwan; and Kew Gardens (but the report from
Kew Gardens is a probable misidentification by Beddard of *M. californica*).

Locality: this description is extracted from the references give in the synonymy and from the
author's Japanese studies.

Habitat: ?

Behaviour: male pores evert like twin "air-bags" for copulation.

Length: 80-90.

Width: 2-3 mm.

Segments: 90-93.

Colour: golden grey.

Prostomium: epilobous.

First dorsal pore: 12/13.

Setae: numerous (ca. 50-60).

Nephropores: ?

Clitellum: annular 14-16.

Male pores: ca. 0.3 circumference apart in lateral slits of copulatory pouches on 18.

Female pore: on 14.

Spermathecal pores: two pairs in 7/8/9 ca. 0.5 circumference apart.

Genital markings: none.

Septa: 6/7-7/8 thick, 8/9-9/10 aborted.

Dorsal blood vessel: single.

Hearts: last pair in 13.

Gizzard: in 8.

Calciferous glands: absent.

Intestine origin (caeca, typhlosole): in 15; caeca manicate in 27-24; typhlosole present.

Nephridia: meroic.

Male organs: testes/funnels in 10 and 11 in sacs; seminal vesicles large in 11 and 12.

Ovaries: in 13.

Prostates: racemose with S-shaped ducts.

Spermathecae: 8 and 9 with short duct and ampulla and long bent diverticulum.

Gut contents: ?

Remarks: The manicate caeca have three or more 'fingers' and are distinctive for this species.

Other species with large and eversible male pores, possibly also with intromittent organs or pseudo-penes, are *M. bipora* (Beddard, 1900), *M. virgo* (Beddard, 1900), *M. kengtungensis* (Gates, 1931), and questionably *M. quelparta* (Kobayashi, 1937) plus its possible synonym *M. sanseiana* (Ohfuchi, 1951), *M. quadrigemina* (Gates, 1932), and *M. brevipenis* (Qiu & Wen, 1988). Another possible member of this grouping would be Gates' (1972: 199) rather unreliable concept of *Metaphire malayana* (Beddard, 1900) [cf. *M. bipora* and *Pheretima (Pheretima) darnleiensis*].

Sims & Easton (1972: 239) list the subspecies *Metaphire schmardae macrochaeta* (Michaelsen, 1899) which, as described by Michaelsen (1900: 302), is from Japan and "Tiensin, China", thus qualifying as peregrine in one or other place (or both places?), and it was differentiated on details of its anterior setae. It is briefly described below...

Duplodicrodrilus schmardae macrochaeta (Michaelsen, 1899)

Perichaeta schmardae : Michaelsen, 1892: 235.

Perichaeta schmardae var. *macrochaeta* Michaelsen, 1899: 227. From "Japan". Types lost.

Pheretima schmardae var. *macrochaeta* : Michaelsen, 1900: 302.

Metaphire schmardae macrochaeta: Sims & Easton, 1972: 239; ?Easton, 1981: 58 (by reference to Michaelsen, 1892: 235).

Duplodicrodrilus schmardae macrochaeta : Blakemore, 2007.

Diagnosis: As *D. schmardae schmardae* but with 50 or less setae in the anterior and those on segments 4-6 enlarged and ornamented.

Distribution: Japan and China (Tiensin) by Michaelsen (1900: 302).

Remarks: It is not certain that these stated variations are outside of normal intraspecific variability and therefore this name may warrant merger with the nominal subspecies.

Genus *Metaphire* Sims & Easton, 1972

Type species and locality: *Rhodopis javanica* Kinberg, 1867 from Java. [Note: Blakemore (2002) questions the distinction of this taxon from the page prior *Pheretima californica* Kinberg, 1867, as also discussed under this taxon's account below].

Diagnosis: Male pores in copulatory pouches; no nephridia on spermathecal ducts.

Distribution: mostly Oriental region, several species peregrine.

Remarks: Degraded morphs lacking spermathecae cannot easily be distinguished between the genera *Metaphire* and *Pheretima*. As information about the occurrence of nephridia on spermathecal ducts is frequently omitted from earlier descriptions, Sims & Easton (1972: 218) say some current members of *Metaphire* may yet prove to belong to *Pheretima*. Moreover, Sims & Easton (1972) caution that preservation may cause evagination of copulatory pouches and therefore a false resemblance to the superficial male pores of *Amyntas*. These authors (Sims & Easton, 1972: 199, 214) provided a provisional list of nominal species (and subspecies), they further assumed a taxon to belong in *Amyntas* unless copulatory pouches were proven, thereby several members of the *Metaphire hilgendorfi* species-complex were retained in *Amyntas*.

Metaphire acincta (Goto & Hatai, 1899)

Perichaeta acincta Goto & Hatai, 1899: 16, fig. 6. From Tokyo. Types?

Pheretima acincta : Michaelsen, 1900: 252.

Amyntas acinctus : Beddard, 1900: 650; Sims & Easton, 1972: 235 [*hawayanus* (= *gracilis*) group]; Easton, 1981: 48 (syn. ?*phaselus* Hatai, 1930; ?*maculosus* Hatai, 1930; ?*kamitai* Kobayashi, 1934; ?*phaselus tamurai* Kobayashi, 1938).

Pheretima yezoensis Kobayashi, 1938: 412, fig. 4. From Hakodate from a "cultivated field".

Types?

Diagnosis: Spermathecal pores in 5/6/7/8. Male pores within copulatory pouches that extend just into 17 and 19. Genital markings absent. Intestinal caeca simple often with incised margins. Spermathecae with diverticula up to twice as long as ampullae.

Distribution: Japan, Tokyo to Hokkaido.

Remarks: Originally erected for two ac clitellate specimens, hence the name, matures are naturally clitellate. Cf. *A. phaselus*. Although Sims & Easton (1972) have *Metaphire yezoensis* in a *Metaphire merabahensis* species-group, Ishizuka (1999a: 56), as was suggested by Yamaguchi (1962) and Kamihira (1973), placed it in synonymy of *Amyntas acinctus* whereas Easton (1981) maintained "*Metaphire yezoensis*" separately.

***Metaphire californica* (Kinberg, 1867)**

Pheretima californica Kinberg, 1867: 102. From San Francisco. Type in Stockholm: 160.

Pheretima modesta Michaelsen, 1927: 88. Types in Hamburg: 10423.

Pheretima molesta Gates, 1932: 420 (nom. nov. pro *P. browni* Gates, 1931: 371 (non *P. browni* Stephenson, 1912: 273). Types missing.

(*Pheretima sakaguchii* Ohfuchi, 1938c: 53)?

(*Pheretima sonaiensis* Ohfuchi, 1956: 154)?

Pheretima californica : Gates, 1972: 174 (syn. *modesta*, *molesta*).

Metaphire californica : Easton, 1981: 57 (syn. ?*sakaguchii*, ?*sonaiensis*).

Diagnosis: Spermathecal pores in 7/8/9 (rarely 6/7/8/9). Male pores in copulatory pouches on segment 18. Genital markings absent. Intestinal caeca simple and often, but not always, with incised margins.

Distribution: Oriental origin, widely distributed globally by human activities. In Japan, widespread from Honshu to Okinawa (Easton, 1981).

Remarks: Descriptions of *Metaphire californica* (Kinberg, 1867) are similar to those of *M. javanica* (Kinberg, 1867) and, if these taxa eventually prove to be synonymous, the former name has page priority (see Blakemore, 2002: 191).

[[Start of *Metaphire hilgendorfi* / *Amyntas tokioensis* species-complex]].

***Metaphire hilgendorfi* / *Amyntas tokioensis* species-complex**

Amyntas tokioensis species-group (part) Sims & Easton, 1972: 237.

Amyntas hilgendorfi species-complex Easton, 1981: 35; 51 [“included species”:
hilgendorfi (syn. *rokugo*, *irregularis*, *schizopora*); *tokioensis*; *sieboldi*: Beddard, 1892b; Goto & Hatai, 1898: 65 [non Horst, 1883 (= *Metaphire sieboldi*)]; *vittata*; *agrestis*; *glandularis*; *levis*; *communissima* (syn. *sieboldi* : Goto & Hatai, 1898); *sieboldi lenzi*; *ambigua*; *yunoshimensis*; *tappensis*; *gomejimensis*].

***Metaphire hilgendorfi* / *Amyntas tokioensis* species-complex** Blakemore, 2003: 1, 7, 26;

[currently INCLUDED SPECIES are given below including *A. parvicystis*].

Composite diagnosis of *M. hilgendorfi* / *A. tokioensis* species-complex: Spermathecal pores absent, single or paired in some of 5/6/7/8 or 6/7/8/9 (e.g. in parts of *A. yunoshimensis*) or 6/7/8 or 6/7 or 7/8 [cf. 7/8/9 in *D. schmardae*]. Male pores absent, aberrant, or when present superficial (*Amyntas*) or non-superficial and sometimes in copulatory pouches (*Metaphire*). Genital markings absent, or as clusters of one or more

papillated pores or as indistinct pigmented areas on pre- and post-clitellar segments (typically segmental, multiple mid-ventral in *M. hilgendorfi* or near intersegmental and paired in *A. tokioensis*). Intestinal caeca non-simple, variably incised or manicate originating in segment 26 or 27. Body may be laterally striped with paler intersegments although this was not described on earlier, original descriptions so is an uncertain characteristic for the group.

[Note: the spermathecal diverticular bulbs of specimens identified with both *A. tokioensis* and with *M. hilgendorfi* in the current study have been found to vary, sometimes within a single specimen from one side to the other, from elongate to spherical – and in the latter case not filled with the usual white coagulum. The diverticula may therefore be likened to balloons that expand and elongate only when inflated following copulation. It thus appears that the actual shape of the spermathecae, themselves usually important taxonomic characteristics, may vary considerably in these parthenogenetic morphs].

This diagnosis above is based on the original descriptions, information given by Michaelsen (1900) and Easton (1981), and personal observations. *A. koreanus* is a new addition to the complex cf. Blakemore (2003).

Distribution of *M. hilgendorfi* / *A. tokioensis* species-complex: Japan, Korea, China (eg. *M. yamadai*), Kunashir Island adjacent to Hokkaido in the Kuril group of Far East Russia (Perel, 1997: 263; Anon, 1997); three taxa, *agrestis*, *hilgendorfi* and *levis*, have been reported as introductions into North America (Edwards & Lofty, 1977: 63; Easton, 1981: 53) although these names may be synonyms according to some authors. Components of the *M. hilgendorfi* species-complex not recorded from Japan, from Easton (1981: 52), were: *gucheonensis* Song & Paik, 1970; *jiriensis* Song & Paik, 1971 (both in the *A. tokioensis*-species group); *koreana* Kobayashi, 1938; and *shinkeiensis* Kobayashi,

1938; to this list may be added nine taxa with manicate caeca recently proposed by Hong & James (2001a) that were mutually compared and differentiated, with scant consideration given to previous Japanese taxonomy, and the Korean *Amyntas paiki* Hong, 2001 that is possibly a synonym of *A. tokioensis*.

Remarks on *M. hilgendorfi* / *A. tokioensis* species-complex: Resolution of the *Metaphire hilgendorfi*/*Amyntas tokioensis* species-complex is one of the most pressing and seemingly intractable problems in Japanese (and Korean) earthworm systematics. The unsatisfactory diagnosis above is revised to accept male pores in copulatory pouches, and therefore *Metaphire* species, as several component taxa have this condition, including those samples of *M. hilgendorfi* that actually have male pores. Many species names have been created for parthenogenetic morphs and further synonymy is possible within this group (see *species incertae sedis* below). I concur with Easton (1981) who stated that insufficient data are yet available either to establish the validity of the component taxa or to recognize discrete subgroups. Contributions by Ishizuka (1999a; 1999b; 2000d, 2001) have not much clarified the situation. Several species recently described by Hong & James (2001a) possibly also belong within this species complex. It may be further remarked that comments by Easton (1979) on the developmental stages of copulatory pouches in *Metaphire* means the generic allocation of several taxa may be further complicated by sub-maturity as well as by parthenogenetic degradation of male pores.

More work is obviously required to sort the parthenogenetic morphs into their respective taxa, and also to separate *Amyntas* species from *Metaphire* species, assuming that these genera are tenable within such a species complex subject to male pore degradation. However, it is possible that *Amyntas tokioensis* (Beddard, 1892) if it

actually has manicate caeca, is representative of an *Amynthas* group that can be separated off from the *Metaphire hilgendorfi* species-group.

INCLUDED SPECIES RECORDED FROM JAPAN:

Amynthas agrestis (Goto & Hatai, 1899)

[Fig. 4.1](#) *Amynthas agrestis* (Goto & Hatai, 1899). Sketches of two specimens from Ami, Ibaraki-ken (collected by author and others, August, 2006), plus original text-figure of a spermatheca.

[Fig. 4.2](#) *Amynthas agrestis* compared with *M. hilgendorfi* from Hatai (1930; figs. 1-3).

Perichaeta agrestis Goto & Hatai, 1899: 17, fig. 7 (sketch of a spermatheca). From Takahashi (Okayama-ken), Tokorozawa (Saitama-ken) and Oarai (Ibaraki-ken).

Types unknown.

Pheretima agrestis : Michaelsen, 1900: 313 (“possibly a variety of *P. hilgendorfi*”); Yamaguchi, 1930: 51, fig. 3; Kobayashi, 1938: 141; Gates, 1953: 5; 1958: 1-3 (?syn. *hataii*); Hatai, 1930: 651, figs. 1-3; Yamaguchi, 1962: 25, fig. 10; Ishizuka *et al.*, 2000b: 179 [highly confused description (even the synonymy is wrong and misses Hatai's crucial 1930 paper cited above). Ishizuka *et al.* have “Three pairs of spermathecal pores in 6/7/8” repeated as “Three pairs of spermathecae on segments VIII-IX” and “Male pores simple, superficial on segment XVIII, but rarely found”, thus a possible misidentification]; Ishizuka, 2001: 67, 103 (syn. *hataii*).

Amynthas agrestis : Beddard, 1900: 637; Sims & Easton, 1972: 235; Easton, 1981: 51 (not explicitly assigned to a genus).

Pheretima striata Ishizuka, 1999b: 53, figs. 91-101. From Mt Mitake, Hino City; other material claimed from Institute for Nature Study, Itsukaichi City. Said to have large, stubby penes in 3% of specimens that extend from 17/18 to postsetal

region of 18; but in Ishizuka's (1999b: figs. 93, 99-101; 2001: 67, fig. 17.7a-7c) these are shown to be merely genital markings, probably indistinguishable from those shown on the same page by Ishizuka (2001: 67, figs. 16.7a-7c) for what he calls "*Pheretima agrestis* (Goto & Hatai, 1899)".

Metaphire agrestis : Blakemore (2005) (syn. *hataii*).

Distribution: From Japan and Korea (e.g. Hatai, 1930:653; Kobayashi, 1938: 141; Hong *et al.*, 2001: 265) and reported as introduced into North America e.g. by Edwards & Lofty (1977: 63), Gates (1958; 1982) who thought it introduced from Japan with imported materials, and by Callaham *et al.* (2004 see http://www.srs.fs.usda.gov/pubs/ja/ja_callaham001.pdf).

Diagnosis: Spermathecae paired in 5/6/7/8; markings as closely paired darker patches or puckered stripes on 7 and/or 8 and sometimes on 6 and 9, or "without the modified patches" (Goto & Hatai, 1899: 17); tumid circular genital markings with central invaginated area sometimes present paired presetally on 18 that lack glands internally; male pores when present mistakenly reported to be on penes (e.g. *striatus*) or if *P. hataii* was included in synonymy slightly invaginated (i.e., = *Metaphire*), however in newly inspected material (R.J.B. pers. obs.) from Ibaraki-ken the male pores were found to be small and superficial in setal arc below tumid genital markings (i.e. in *Amyntas*). Intestinal caeca appear to vary in specimens from deeply incised or hemi-pinnate to manicate or almost complex, perhaps this latter condition is found in older specimens. [A similar situation seems to occur in *M. yamadai* as Chen (1933: 259, fig. 21) shows variation from deeply incised to manicate caecae].

The original description of more than one hundred included a few specimens (from Oarai, Ibaraki) that had a pair of large papillae presetally in 18, and a few others

without the anterior genital patches and these would presumably be indistinguishable, apart perhaps from convoluted spermathecal diverticula, from Goto & Hatai's subsequent *M. communissima* that is described separately below.

Hatai (1930: 653) states that most *agrestis* from Hokkaido possess male pores, and Gates (1958: 1-3) mentioned that Kobayashi (1938) found two from 246 Korean specimens had genital markings and male pores on 18 so that Gates believed specimens from around Sapporo would provide needed intermediate forms, although these would need to be compared to *M. hataii*. While Ishizuka (1999a: 57) listed a misnamed "*Pheretima* HATAI & OHFUCHI, 1937, p. 13" as "**syn. n.**" of *Pheretima agrestis* (Goto & Hatai, 1899), this was later corrected to *Pheretima hataii* Ohfuchi, 1937 by Ishizuka (2001: 103), although these two taxa were already combined by Gates (1938) or retained separately, as *Amyntas agrestis* and *Metaphire hataii*, by Sims & Easton (1972) and Easton (1981) on a probable basis of differences in the form of the male pores (where present).

For Ishizuka's *P. striata*, one or maybe two specimens [stated to be 3% of 35 specimens (= 1.05 worms??) although possibly not the holotype despite the figure legends for Ishizuka's (1999b: figs. 91-101) being confused] were said to have male pores: but the "penes stubby and large" are actually genital markings, and probably the actual male pores exiting superficially in the setal arc [from prostatic glands figured in Ishizuka (1999: fig. 8)] were overlooked, just as the setae were missed in Ishizuka's (1999: fig. 7a cf. 7b). Some examples of *P. agrestis* shown on the same page as *P. striata* in Ishizuka (2001: 67) had similarly large and irregularly paired presetal papillae on 18, as were described for a few of Goto & Hatai's original specimens.

Amyntas ambiguus (Cognetti, 1906)

Pheretima ambigua Cognetti, 1906: 782, fig. 7 [non *Pheretima barbara ambigua* Cognetti, 1913: 302 (= *Pheretima (Parapheretima) barbigua* Blakemore, 2004 replacement name under ICZN, 1999: Art. 57.2 Examples)]. From Yokohama. Type in Vienna: 3979.

Amyntas ambiguus : Sims & Easton, 1972: 236, 240 (*Amyntas illotus* species-group); Easton, 1981: 51 (*Amyntas hilgendorfi* species-complex).

Remarks: Length ca. 95mm. Lacking spermathecae and prostate glands, but with manicate intestinal caeca. Gates (1958: 23) said “The type on which *P. ambigua* Cognetti, 1906, was erected is of an AR morph indistinguishable from *irregularis*” that he therefore included under *Pheretima levis*. Compare with *A. tokioensis* and *Amyntas koreanus*.

***Amyntas gomejimensis* (Ohfuchi, 1937)**

Pheretima gomejimensis Ohfuchi, 1937a: 18. From Oshima and Gomejima (Aomori-ken). Types?

Amyntas gomejimensis : Sims & Easton, 1972: 237 (*tokioensis*-group); Easton, 1981: 52; Ishizuka, 1999a: 59 (misspelled “gomejimaensis”).

Remarks: *Amyntas gomejimensis* was stated by Ohfuchi (1937: 19, 24) to resemble *Pheretima servinus* (= *Metaphire servina*) or his own *P. hataii* (cf. *Amyntas agrestis*) in all characters except for its lack of genital markings on 18; thus, because no fully mature specimens were found, the relationship is most likely with either of these two previous taxa.

***Amyntas koreanus* (Kobayashi, 1938)**

Pheretima koreana Kobayashi, 1938: 115, fig. 5. Korea. About a dozen specimens.

Amyntas koreanus: Sims & Easton, 1972: 236 (*A. morrissi*- group).

Pheretima conjugata Ishizuka, 1999b: 34. Japan. About a dozen specimens - synonym as per Blakemore (2003: 43, addenda).

Remarks: Various described as either having paired or unilateral spermathecal pores in 6/7 or 5/6 with deformed spermathecae, or lacking them completely, and often lacking genital markings and male pores; size 90-140 mm. In neither of the above cases is the condition in the holotype explicitly stated, but irrespectively these names may be 'grab bags' of degraded morphs of more than one unresolved species with no particular biogeographic nor phylogenetic merit. Their manicate caeca probably place them in one or more parts of the *Metaphire hilgendorfi* species-complex: most likely associated with *Pheretima irregularis*, from which neither Kobayashi (1938) nor Ishizuka (1999b) managed to adequately differentiate them, or possibly to *A. ambiguus* (Cognetti, 1906). There is almost no difference in the degraded specimens that Ishizuka (2000) unnecessarily provided with a name from those described earlier by Kobayashi (1938), showing that little new has been learned during the last 60 years.

In these most recent revisions (August 2004; January, 2005) it seems to me that these taxa (*koreana*, *conjugata*) are the same as *P. schizopora* (Goto & Hatai, 1898:76), especially since the justification for their original name was for a pair of female pores and Ishizuka (1999b: fig. 8) appears to show separate pores for his *P. conjugata* (not that this is a reliable taxonomic character) and, moreover, that this latter taxon is probably synonymous with *A. tokioensis* (Beddard, 1892), into which all these names should be sunk.

Amyntas parvicystis (Goto & Hatai, 1899)

Perichaeta parvicystis Goto & Hatai, 1899: 18, figs. 8, 8a, 8b. From Uwajima (Ehime-ken,

Shikoku) and Oarai (Ibaraki-ken, Honshu). Types?

Pheretima parvicystis : Michaelsen, 1900: 316 (“perhaps a variety of *P. tokioensis*”).

Amyntas parvicystis : Sims & Easton, 1972: 237; Easton, 1981: 56.

Diagnosis: Spermathecal pores stated to be presetal on 7 and 8, (or more likely in 6/7/8?).

Male pores superficial on segment 18. Genital markings paired glandular pores near spermathecal pores (in 7 and 8) and usually with two pairs just median to male pores.

Intestinal caeca simple incised (or more likely manicate?). Prostate glands aborted (always?).

Distribution: Japan.

Remarks: This species name, maintained separately by Easton (1981), was thought a possible variety of *Amyntas tokioensis* (Beddard, 1892) by Michaelsen (1900) and, maybe because of this, was also held by Ishizuka (1999a: 66; 2001: 102) in synonymy of “*Pheretima tokioensis*” that is now returned as *Amyntas tokioensis* after its previous inclusion in the *Metaphire hilgendorfi* species-complex characterized by intestinal caeca that are manicate. *A. parvicystis* was originally described by Goto & Hatai with a single pair of caeca with the “external margins frizzled” and stated to be similar to the condition found in *Amyntas digitatus* (Benham, 1896) and *A. bonthainensis* (Benham, 1896), and Sims & Easton (1972: 173, Fig. 11) show *A. digitatus* with multiple (= manicate) intestinal caeca. However, Goto & Hatai (1899: 23) failed to include *A. parvicystis* in their list of species with manicate caeca (although they also miss their own *agrestis* and mistakenly include *divergens* in this list), and they had earlier overlooked the caeca of their *P. iizukai* and had misdescribed the multiple caeca of their *P. megascolidioides*. Yet Easton (1981) appears to have accepted that the caeca of *A. parvicystis* were simple with incised margins. Almost certainly Goto & Hatai confused the position of the spermathecal pores with those

of the genital markings (as they did both for their *P. obscura* and *P. vittata*). Moreover, Sims & Easton (1972: 237) for unexplained reasons include *A. parvicystis* in their *tokioensis*-group characterized by spermathecal pores intersegmental in 6/7/8. Thus there is some ambiguity of the exact condition of caeca and spermathecal pores for this taxon.

Nothing matching the original description has been re-discovered thus far [except for a dubious report by Kobayashi (1941a)] and, if both their respective caeca are manicate, most likely it is merely a synonym of *A. tokioensis* [for which Ishizuka's *P. verticosa* is also a synonym with his figures (Ishizuka, 1999b: 50, figs. 75-83) complying almost exactly with Goto & Hatai's figures]. If, however, the spermathecal pores are actually in (6/7/8/9) rather than 6/7/8, then this species would be similar to *A. robustus* that does have simple but incised caeca and a similar distribution of genital markings.

Amyntas purpuratus (Ishizuka, 1999b).

Pheretima purpurata Ishizuka, 1999b: 42 [misspelt "*purpuratga*" by Ishizuka (2001: 14)],

[non *Perichaeta purpurea* Benham, 1897 (= *Amyntas purpureus*)].

Remarks: The description is confused regarding the distribution of anterior genital markings, and it is probable that this species is similar to *Amyntas tappensis* (Ohfuchi, 1935) and therefore in synonymy of *A. vittatus*, but this needs confirmation from inspection of types.

Amyntas tappensis (Ohfuchi, 1935)

Pheretima tappensis Ohfuchi, 1935: 409, figs. 1-5. From Tappi, Higashi-Tsugaru district,

Aomori northeast Honshu - the closest point to Hokkaido. Types unknown.

Amyntas tappensis : Sims & Easton, 1972: 237; Easton, 1981: 52.

Pheretima bimaculata Ishizuka, 1999b: 42; 2001: 60.

Pheretima silvatica Ishizuka, 1999b: 46; 2001: 63.

?*Pheretima surcata* Ishizuka, 1999b: 48; 2001: 63. (cf. *A. tokioensis*); [Ishizuka (2001: 63) has miscounted segments and erroneously states spermathecal pores are in "5/6/7" although the original description, and all figures, show them in 6/7/8].

Amyntas odaesanensis Hong & James, 2001: 86, figs. 5F-H. From Korea.

Amyntas righii Hong & James, 2001: 87, figs. 5I-L. From Korea.

Amyntas fasciiformis Hong & James, 2001: 89, figs. 5M-O. From Korea.

?*Amyntas sanchongensis* Hong & James, 2001: 90, figs. 5P-T. From Korea.

Diagnosis: Size 40-208 mm, segments 54-115, setae 32-64. Brown dorsum. Male and spermathecal pores ca. 0.4-0.5 circumference apart with about 16-25 setae between male pores. Spermathecal pores in 6/7/8 (probably). Genital markings as one or more small papillae postero-median to position of spermathecal pores in some or all of 7-8,9 (probably) and antero-median to relative position of male pores in some or all of 17-19,20. Intestinal caeca manicate.

Distribution: More than sixty years ago, Kobayashi (1941c: 380) reported *Ph. tappensis* from Kinki, through Kanto to Tohokku regions of Honshu, i.e., much of central and northern Japan, well encompassing the range of all of Ishizuka's specimens. Korean records are more recent.

Remarks: Descriptions of all three of Ishizuka's species are highly confused regarding the location of spermathecal pores and distribution of genital markings, but all are mutually similar, allowing for natural variation, and they all also resemble *Amyntas tappensis* (Ohfuchi, 1935) thereby possibly qualifying for synonymy along with *A. vittatus* (Goto & Hatai, 1898) in *A. tokioensis* (Beddard, 1892) - see also *A. purpuratus*.

Examples of the confusions are that the Ishizuka's description of *bimaculata* has markings stated in 9-10 and spermathecae in 6/7/8. But his Fig. 38 shows markings in either 8-9 or 9-10, and his fig. 39 has them in 7-8 [this same figure is copied in Ishizuka (2001: 60, fig 3a) but now has them in 8-9 and spermathecae in 7/8/9]. Moreover, his description of *surcata* had spermathecal pores quite clearly stated to be in 6/7/8 (spermathecae in 7 and 8), while the markings were said to be in presetal in 7-8 and in 18. Yet his Fig. 65 possibly has the segments miscounted, and Fig. 66 show spermathecae in 5/6/7 and only one marking in 7 (or is the legend wrong?). Also the key in Ishizuka (1999b: 55), apart from having "markings absent", has "genital glands complex duct type" (even though they are stated in the description to be either simple **or** complex in both his *silvatica* and *surcata*) and in the next couplet he confuses *surcata* with *verticosa*, albeit they may indeed be identical species, both belonging in *A. tokioensis*. Unremarkably, these latter errors in the figures are perpetuated in Ishizuka (2001: 60, 63) and a research imperative is to reinspect types and redescribe these taxa.

Ishizuka's *silvatica* which was based on either 9 or 10 specimens, may differ slightly in having first dorsal pores in 11/12 rather than 12/13 (normal variation?) and seminal vesicles given in the unlikely location of 10-11 rather than 11-12 (albeit the figure legend for these is also mis-scaled), and these may just as easily be miscounts.

Hong & James' *A. odaesanensis*, *A. righii*, *A. fasciiformis* and *A. sanchongensis* are all mutually compared, agree with each other, and fall within variation of Ishizuka's specimens and thus are also likely synonyms within the ambit of *A. tappensis*. The latter species, *Amyntas sanchongensis*, is even described with "eight of sixteen" specimens lacking genital markings near the spermathecal and male pores and therefore, presumably, almost impossible to distinguish between *A. tokioensis* and/or *A. tappensis* specimens that

also lacked markings. Hong & James (2001: 91) compared this latter species only with the sympatric *A. jiriensis* (Song & Paik, 1971) saying "it differs in the shape of male pore region and the genital markings..." and I take it that they meant to add '...when these are present...'. Moreover, if not synonymous, male pores in *sanchongensis* may be strictly non-superficial and thus it would presumably qualify for *Metaphire*.

The real question, despite all this diversion, is the relationship of *A. tappensis* to the prior *A. vittatus*, and to *A. tokioensis* as redescribed below.

Amyntas tokioensis (Beddard, 1892)

[Fig. 5.1](#) *Amyntas tokioensis* (Beddard, 1892). Sketch of previously dissected type specimen (BM:1904:10:5:166) showing spermathecae and glands in 7 and prostate ducting to rhs male pore *in situ* with a spermatheca found in a vial (from 8 rhs or lhs, other spermatheca missing from jar). Manicate intestinal caeca is from around segment 26 rhs. Enlargements are of spermathecal region (7 lhs) and male pore region (18 lhs). Clitellum is shown shaded.

[Fig. 5.2](#) *Amyntas tokioensis* (Beddard, 1892). Rough sketch of internal arrangement of spermathecal and male field of type specimen (not to scale). X - site of previously removed or cut out genital gland, spermathecae, and prostate gland.

[Fig. 5.3](#) *Amyntas tokioensis* (Beddard, 1892), *P. schizopora* and *P. irregularis* compared showing spermatheca with ampulla and genital marking glands.

Synonymy:

Perichaeta tokioensis Beddard, 1892b: 762 [Published December, 1892 according to Michaelsen, 1900: 272]. From Japan (Tokyo, as in "tokioensis"?). Holotype in British Museum: 1904.10.5.166 (inspected by Sims & Easton, 1972: 181, 191 and re-inspected here at YNU in Dr M. Ito's laboratory).

?*Perichaeta vittata* Goto & Hatai, 1898: 74. From Tokyo, Kamakura; no types. [Markings, 3 presetal and lateral pairs in 7 and 8; spermathecae absent or a single pair in 8 (or two pairs in 7/8/9?); prostates aborted; caeca manicate].

?*Perichaeta schizopora* Goto & Hatai, 1898: 76. From Tokyo. No types. [Spermathecal pores in 7/8, the spermathecae in 8 irregular: the one on the left side had "three diverticula" (they may have mistaken two copulatory glands for diverticula), the one the right a normal single diverticulum; prostates aborted; caeca manicate. Oviduct (female) pores were reported as "one pair", "entirely separate", but either this is an abnormal specimen or, since this single acitallate specimen was not fully mature (hence no genital markings), the absence of a tumid clitellum may cause the pores to appear separately. Either way, the presence of paired rather than separate female pores is not a particularly 'good' character and in every other reported respect, this 'species' is probably the same as *P. vittata* and also resembles the current redescription of *A. tokioensis*].

?*Perichaeta irregularis* Goto & Hatai, 1899: 13 (not figured). [Non *Perichaeta irregularis* Spencer, 1895: 53 (= *Perionychella irregularis*), however, a replacement name for the permanently invalid junior primary homonym is not provided under ICZN (1999: Arts. 23.9.5, 57.2, 82) as the two names were "not considered congeneric after 1899", eg. Michaelsen (1900: 206, 276) had them in separate genera. Cf. *M. hilgendorfi* synonymy below]. From Uwajima, western Shikoku, and Takahashi, that is adjacent to the north of Shikoku in Okayama-ken. No types. [Intestinal caeca manicate but spermathecae, genital markings, prostates and male pores absent, therefore a highly degraded parthenogenetic morph that could belong to any number of similar taxa; cf. *M. hilgendorfi*, *A. parvicystis*. Nakamura (1994: 29) lists it as a separate taxon "*Amyntas irregularis* (Goto et Hatai) Ohfuchi"].

Perichaeta levis Goto & Hatai, 1899: 20, fig. 12. [See also its separate description below].

From Takahashi Okayama-ken and Kumamoto (Kyushu). No types. [Spermathecae and copulatory glands exactly as in *tokioensis*, male pores and prostates absent, which is probably why Goto & Hatai found them “difficult to recognize with the naked eye”; cf. *M. hilgendorfi*].

Pheretima levis: Kobayashi, 1938: 129 fig. 7, from Korea; Gates, 1958: 21-24 (?syns. *irregularis*, *ambigua*, *vittata*, *schizopora*), from USA. Spermathecal pores in 6/7/8, genital markings paired in 8 and/or near spermathecal pores, male pores absent, caecae manicate - i.e., agreeing with current redescription of *A. tokioensis*.

Amyntas (sic) *tokioensis* : Beddard, 1900: 633 (syn. *candida* Goto & Hatai, 1998: 77; *parvicystis* Goto & Hatai, 1899: 18). [These synonyms were not universally accepted and, moreover, the type of *tokioensis* is now known to have manicate intestinal caeca whereas the intestinal caeca of these others names are still rather uncertain].

Pheretima tokioensis : Michaelsen, 1900: 309, 316 (?syn. *parvicystis*).

Amyntas tokioensis : Sims & Easton, 1972: 237; Easton, 1981: 51; Blakemore, 2003a: 243 (syn. *verticosa*): Blakemore, 2003b: 7, 27, 43 (syn. ?*vittatus*, ?*tappensis*, ?*parvicystis*, *verticosa*, ?*eastoni* Hong & James, 2001, ?*boletiformis* Hong & James, 2001).

?*Pheretima jiriensis* Song & Paik, 1971: 193.

Pheretima verticosa Ishizuka, 1999b: 50, figs. 75-83; 2001: 64.

?*Pheretima irregularis* : Ishizuka, 2001: 19, 20, 53, 54, 61 - sometimes misspelt "*irreguralis*" and probable misidentifications, although it may yet be a synonym.

[?*Amyntas yongshilensis* Hong & James, 2001: 80, figs 4A-C. From Korea. Sympatric

on Quelpart Island with *Amyntas alveolatus* Hong & James, 2001 that is exactly the same as *A. kanrazanus incretus* (Kobayashi, 1937) and comparable to *A. kanrazanus kanrazanus* (Kobayashi, 1937) that is itself similar to *A. tokioensis*].

Amyntas eastoni Hong & James, 2001: 83, figs 4M-Q (on page 80). From Korea.

Amyntas boletiformis Hong & James, 2001: 84, figs 5A-E. From Korea.

?*Amyntas paiki* Hong in Hong, Lee & Kim, 2001: 266, fig. 4. From Korea. [See <http://zoolstud.sinica.edu.tw/Journals/40.4/263.pdf> where the taxon is compared only to *A. taebaekensis* Hong & James, 2001 that, however, has simple rather than manicate intestinal caecae, and spermathecal pores in 5/6/7 rather than 6/7/8].

Distribution: Japan, Hatai (1929) described it from Aomori, through Miyagi to Shikoku, and from Oshima and Kagoshima-ken. Korea (eg. Kobayashi, 1936a). Also reported from USA as *Pheretima levis* by Gates (1958: 21-22) or as *Metaphire levis* (Goto & Hatai, 1899) by Easton (1981: 53) and, at least from New York, North Carolina and Tennessee, by Wetzel (2005); and as *Amyntas vittatus*, from Ashford, northeastern Connecticut by Schneider & McDevit (2002) – see Blakemore (2005)].

Diagnosis: Spermathecal pores widely paired ca. 5 mm apart compared to body diameter of 6 mm in 6/7/8 (or one or more absent – pers. obs. including a single specimens with no spermathecae nor anterior markings but with markings near superficial male pores in 18); genital markings paired just in front of the setal arcs on 7 and/or 8 (originally said by Beddard to be in 8 and 9 but more likely in 7 and 8 due to the position of the internal glands here) just medial to the spermathecal pores, with two or three glandular pores near to and medial to the male pores (all markings with various glands internally, those near the spermathecae may "unite to open close to, if not in common with, the spermatheca of segment VIII" - Beddard). [Or genital markings absent?]. Spermathecae “of exactly

the same form as in *Perichaeta rokugo*" (= *M. hilgendorfi* i.e., with diverticula long and thin but widened proximally).

Intestinal caeca now known to be manicate (pers. obs.). Beddard (1892b: 763) originally stated that "there are only the usual two caeca in segment 26" and so Michaelsen (1900) quoted the intestinal caeca form as "usual", but Sims & Easton (1972: 191), after inspection of the holotype, stated it is multiple (= manicate as confirmed here) thus Easton (1981) included it in his *Amyntas hilgendorfi* species-complex. Michaelsen and later Beddard (1900) also thought that *A. parvicystis* (Goto & Hatai, 1899: 18) was possibly a variety of *A. tokioensis* with which I am inclined to agree, allowing for errors in the original account such as the confusion of genital markings with spermathecal pores and *vice versa*. It is also possible that the various degraded morphs of *A. vittatus* and *A. tappensis* may also be synonymous, and therefore so too are all known synonyms of these two taxa.

Easton (1979: 119) added *gucheonensis* Song & Paik, 1970 and *jiriensis* Song & Paik, 1971 to the *A. tokioensis*-species group of Sims & Easton (1972) that raised it to 20 nominal taxa - with many of these synonyms. M.T. Ito (pers. comm. January, 2007) believes that *A. jiriensis* is also a synonym of *A. tokioensis*.

Ishizuka's *P. verticosa* largely complies with what is known of *A. tokioensis* and also with some of the possibilities, as noted under its account, in the highly confused description of *P. parvicystis* by Goto & Hatai (1899: 18). Figures accompanying Ishizuka's (2001: 61) redescription of "*Pheretima irregularis* (Goto & Hatai, 1899)" correspond closely what is known of Beddard's (1892b) earlier taxon (having spermathecal pores in 6/7/8, glandular markings on 7, 8 and 18, and manicate intestinal caeca), and may thus prove to actually be of *A. tokioensis*. Originally, *P. irregularis* was based on

specimens with manicate caeca but that lacked spermathecae, genital papillae and male pores!

Following recent inspection of the type by Sims & Easton (1976) and per. obs., we can now accept that the intestinal caeca are indeed manicate, and male pores (when present) are superficial; thus *Amyntas tokioensis* becomes the representative taxon of an *Amyntas tokioensis* species-group currently combined, uncomfortably, within the *Metaphire hilgendorfi* species-complex, that would be redefined to accept spermathecal pores in 6/7/8, or just in 7/8, or absent.

Hong & James' (2001) *A. yongshilensis*, *A. eastoni* and *A. boletiformis* also agree, with each other, with *parvicystis* and, thus are likely synonyms of *A. tokioensis* or, at the very least, would belong in an *A. tokioensis* species-group (- synonymy as per Blakemore, 2003: 43, addenda). A further possible synonym is *Amyntas paiki* Hong in Hong, Lee & Kim, 2001- <http://zoolstud.sinica.edu.tw/Journals/40.4/263.pdf>

[*Amyntas vittatus* (Goto & Hatai, 1898) [cf. *A. tokioensis* account above].

Perichaeta vittata Goto & Hatai, 1898: 74 (crudely figured). From Tokyo, Kamakura [later as "Tokio and Yokohama" in Table 3 of Hatai (1929: 281)]. Types?

Amyntas vittatus : Beddard, 1900: 635.

Pheretima vittata : Michaelsen, 1900: 312; Cognetti, 1906: 783 (Yokohama), figs. 8-11; Hatai, 1929: 271, figs. 1-2; Ishizuka, 2001: 64.

Amyntas vittatus : Sims & Easton, 1972: 236 (*pomellus*-group with spermathecal pores in 7 & 8, but this obviously a mistake); Easton, 1981: 51.

Distribution : Japan and Korea; Hatai (1929) described it from Aomori, through Miyagi to Shikoku, and from Oshima and Kagoshima-ken. Also reported from northeastern

Connecticut, USA by Schneider & McDevit (2002).

Diagnosis: Spermathecae, at most, paired in 6/7/8; genital markings absent or in paired sets of one to six papillae linearly in 7 and 8 just in front of setal line (rarely in 5, 6 or 8 too), and similar markings sometimes near male pore(s), when present, on 18. Intestinal caeca manicate. Banded colouration due to pale setal lines. Size about 100-155 mm.

Remarks: Goto & Hatai's original description confused the pre-setal genital marking glands in 7 and 8 with spermathecae and thus falsely claimed 6 pairs in these two segments (parroted by Cognetti, 1906). Subsequently, Hatai (1929) corrected his earlier flawed account and indicated that spermathecae may be present in some of 6/7/8. As noted under the account of *Metaphire hilgendorfi* / *Amyntas tokioensis* herein, it is possible that Goto & Hatai's subsequent *P. irregularis* is merely a more degraded morph of *A. vittatus* - or some other taxon. Several variable specimens newly collected from Tokyo and/or Hokkaido and studied by the current author agree with *A. vittatus* and tend to have a similar banded colouration dorsally; they also merge characteristics with Goto & Hatai's *schizoporus* and *levis* (in all cases male pores were absent or superficial, i.e., not qualifying for *Metaphire*). It is thus possible that all three taxa (*irregularis*, *schizoporus*, *levis*) are synonymous with *A. vittatus*, which in turn is synonymous with *A. tokioensis*.

What is known is that the markings (when present?) on segment 7 are just in front of the setal arc and are in lateral series of about three on each side. This may well be the most distinct characteristic, although when they are single, double, or missing, then this worm will presumably be similar to several other taxa, especially *A. tokioensis*.

Ishizuka (2001: 64) shows specimens claimed to be *P. vittata* one of the latter with the same markings as found on 7, also on 18 just median to what appear to be superficial male pores; this specimen has two pairs of diverticulate spermathecae with

openings in 6/7/8, perhaps indicative of a sexually reproducing specimen. (Ishizuka's (2001: 61) "*Pheretima irregularis*" is more likely a misidentification of *A. tokioensis*). It is thought that Ohfuchi's *P. tappensis* is also in synonymy along with its various junior synonyms comprising several of Ishizuka's proposed taxa (e.g. *bimaculata*, *purpurata*, *silvatica* and *surcata*). In addition, Hatai & Ohfuchi's *M. servina* may also be closely related, if not synonymous, but with the male pores claimed to be in more defined pouches. Such possibilities require further investigation, but the over-riding consideration is the relationship of *A. vittatus* to *A. tappensis* and the relationship of both to the prior *A. tokioensis*, as discussed under that taxon's account above].

***Amyntas? yunoshimensis* (Hatai, 1930)**

Pheretima yunoshimensis Hatai, 1930b: 655, figs. 4 (of body), 5 (of defective spermathecae and internal capsulogenous glands); Ishizuka (1999a: 67) [name misspelt "*yunoshimaensis*"]; Ishizuka, 2001: 105 [name misspelt "*yunishimaensis*"]. From Sapporo, Hokkaido and Aomori, northern Honshu where Yunoshima is a small island off Asamushi township. Types unknown.

Amyntas yunoshimensis : Sims & Easton, 1972: 237; Easton, 1981: 52.

Remarks: Genital markings as composite papillae in 8 and 18. Due to the original description allowing spermathecae in either 6/7/8 or 5/6/7/8, Sims & Easton (1972: 237) had this taxon partly in an *Amyntas tokioensis*-group with spermathecal pores in 6/7/8, and partly in an "*Amyntas sieboldi*-group" with spermathecal pores in 6/7/8/9; accordingly, this latter condition is added to the *hilgendorfi*-complex diagnosis above (cf. Easton, 1981). Spermathecae mostly appear defective. Male pores were present in specimens from Sapporo (Hatai, 1930: 656) but their form was not described and this

taxon is poorly differentiated from *Metaphire hilgendorfi* with which it shares patches of central genital markings in 8 and 18. In fact, Gates (1958: 13) had earlier said it was indistinguishable (accepting an extra spermatheca or two in 5/6 as mere variation) and thought it a junior synonym of *hilgendorfi*.

Metaphire communissima (Goto & Hatai, 1899)

?*Perichaeta sieboldi* : Beddard, 1892b:759 (cf. *Metaphire hilgendorfi*; *M. sieboldi*).

Perichaeta sieboldii : Goto & Hatai, 1898: 65; Goto & Hatai, 1899: 23 [non *Megascolex sieboldi* Horst, 1883 (= *Metaphire sieboldi*)].

Perichaeta communissima Goto & Hatai, 1899: 23. From Nakahama, Tokyo, Sendai, Tsugaru, Shizuoka, Ibaraki, Bichu. Type material unknown.

Perichaeta sieboldi lenzi Michaelsen, 1899: 9. Types missing.

Pheretima communissima : Michaelsen, 1900: 262 [syn. *Perichaeta sieboldii* : Goto & Hatai, 1898: 65 (non Horst, 1883), *sieboldi* var. *lenzi*]; Ishizuka, 2001: 66.

Amyntas communissimus : Sims & Easton, 1972: 235 (syn. *sieboldi lenzi*); Easton, 1981: 51 (syn. *sieboldi* : Goto & Hatai, 1898).

Pheretima florea Ishizuka, 1999b: 52 [misspelt “*frolea*” in Ishizuka (2001: 66)]. From Mt. Daibosatsu-toge (in Yamanashi-ken), four types in Tokyo National Science Museum.

Remarks: In a footnote, Sims & Easton (1972: 235) state that: “Both *communissimus* and *sieboldi lenzi* were provided for *Perichaeta sieboldi* : Goto & Hatai, 1898 (non Horst, 1883); *communissimus* has priority”. This was already established by Michaelsen (1900: 262), but appears to have been ignored by Easton (1981:51) who listed *sieboldi lenzi* as a

separate “INCLUDED SPECIES” in his *hilgendorfi* species-complex rather than a synonym.

Characteristics of *Metaphire communissima* are spermathecal pores paired in 5/6/7/8; absence of genital markings; male pores apparently in small copulatory pouches; spermathecae with convoluted diverticula; and manicate intestinal caeca. Having male pores in copulatory pouches as shown in Ishizuka (1999b: figs. 84-85; 2001: 66), rather than “on top of papillae” as in the original description, would qualify this taxon for inclusion in *Metaphire*. Michaelsen (1900: 263) stated that the prostatic ducts were thickened at the end but did not have copulatory pouches, which is similar to the arrangements figured by Ishizuka (1999b: fig. 87; 2001: 66). The inadequate morphological characteristics used by Ishizuka to separate his *P. florea* from *M. communissima* (misspelt “*commnissima*”) were a smaller body length, stated to be 60-70 mm, although he has misquoted as “150-250 mm” the accepted range of *communissima* given by Michaelsen (1900: 262) as 90-250 mm; and spermathecal ampullae stated to be “shovel-shaped” in *florea* as opposed to “globular” in *communissima*, even though Michaelsen (1900: 262) had stated they were “flattened”. Ishizuka (2001: 66) redescribes *communissima* on the same page as his *florea* (misspelt “*frolea*”), here giving the respective lengths as 90-180 and 60-80 mm, and figuring other morphological criteria as being indistinguishable (apart perhaps from slight age-related differences). Both figured specimens appear to have male pores in copulatory pouches, supporting their inclusion in *Metaphire*, and are essentially indistinguishable, supporting their synonymy. Were there parthenogenetic specimens of *M. communissima* lacking male pores, these would presumably be similar (synonymous?) to either *A. agrestis* or *M. hataii* specimens lacking genital makings.

Ishizuka (1999b; 2001) implies that geographical or topographic locations of his *P. florea* specimens coming from a Yamanashi-ken mountain is unique, but he appears to ignore the distribution of *M. communissima* given as from around Osaka, through Shizuoka, Tokyo, Aomori and Ibaraki, to Sendai in the north (or as stated by Goto & Hatai: “that is to say all over the Main Island”), that puts Yamanishi-ken in about the middle of the known range.

Relationship of *M. communissima* to the prior *A. agrestis* and subsequent *M. hataii* require resolution as their characteristics overlap possibly indicating synonymy.

Metaphire hataii (Ohfuchi, 1937).

[Fig. 7](#) *Metaphire hataii* (Ohfuchi, 1937). Based on original figures.

Pheretima hataii Ohfuchi, 1937a: 13, fig. 1. From Kyu-sakurayama near Morioka, Iwate-ken. Types unknown.

?*Pheretima agrestis* : Kobayshi (1938: 142, 145).

Metaphire hataii : Sims & Easton, 1972: 238 (*birmanica* group); Easton, 1981: 58.

Notes: Newly restored from synonymy in *A. agrestis* by Blakemore (2005).

Distribution: From northern Japan.

Diagnosis: Spermathecae paired in 5/6/7/8; markings as closely paired dark patches on 7 and paired presetally median to male pores on 18 that lack glands internally

Remarks: Male pores in slight copulatory pouches as in types specimens of *Metaphire hataii*, and as described in 2 out of 248 specimens (of *P. agrestis*) by Kobayshi (1938: 142, 145) qualify this taxon for inclusion in *Metaphire* separate from *Amyntas*.

Metaphire hilgendorfi (Michaelsen, 1892).

Perichaeta hilgendorfi Michaelsen, 1892: 235, fig. 15. [Published in September, 1892] therefore has priority over Beddard's December, 1892 *P. rokugo* and *P. tokioensis*. From 'Japan' (Hakodate, Yokohama and possibly another locality). Types of five specimens of the original seven specimens (i.e., two missing?) in Zoological Museum, Berlin listed by Hartwich & Kilius (1989: 266) after Michaelsen (1892: 237) thus:

2114: Japan; HILGENDORF leg. (1 syntype).

2123: Japan, Hakodate; HILGENDORF leg. (3 syntypes).

2149: Japan, Yokohama; v. MARTENS leg. (1 syntype).

Michaelsen (1892) had five "varieties" thus:

α - (150 mm long) with spermathecae in 6/7/8, GM 8 (3 specimens from Hakodate);

β - spermathecae in 6/7/8, GM 8 and 9 (No. 2149, Marten's specimen from Yokohama);

γ - spermathecae 6/7/8, no GM (one specimen from Hakodate);

δ - spermathecae 5/6/7/8 (one specimen from Hakodate);

ϵ - spermatheca on lhs in 7/8 (No. 2114, one of Hilgendorf's from 'Japan').

Perichaeta rokugo Beddard, 1892b: 756, tab. 32, figs. 1-7 (published in December, 1892).

Spermathecal pores in 6/7 and 7/8; genital markings central on 8; male pores and prostates absent. From "Japan". Types (of four examples?) in British Museum: 1904:10.5.144-145.

?*Perichaeta irregularis* Goto & Hatai, 1899: 13. [Non *Perichaeta irregularis* Spencer, 1895: 53 (= *Perionychella irregularis*) - note: under ICZN (1999: Art. 23.9.5) the junior primary homonym by Goto & Hatai (1899) is not replaced and prevailing

usage is maintained as the two taxa were “not considered congeneric after 1899”, e.g. Michaelsen (1900: 206, 276) at least had them in separate genera - see also Blakemore (2000: 298; 2003: 29)]. From Uwajima and Takahashi. Types unknown. Spermathecae, genital markings, male pores and prostates aborted. Cf. *A. tokioensis* synonymy above.

Perichaeta glandularis Goto & Hatai, 1899: 18, figs. 9-11. From Takahashi. Types unknown. Spermathecae 6/7/8; genital marking patches mid-7 and mid-17/18.

Pheretima hilgendorfi : Beddard, 1895: 409 (syn. *rokugo*); Michaelsen, 1900: 272; 313, 315, 317 [syn. *rokugo*, *sieboldi*: Beddard, 1892: 759 non Horst, 1883 (= *Metaphire sieboldi*), *levis*, ?*agrestis*, ?*glandularis*, ?*schizopora*]; Beddard, 1900: 633 (syn. *rokugo*, *irregularis* Goto & Hatai, *schizopora*); Gates, 1958: 13 (?syns. *yunoshimensis*, *glandularis*); Ishizuka, 2000d; 2001: 61, 103 [syn. *glandularis* (misspelt “galndularis”), *rokugo* (both miscited as "syn. n.")].

[? *Pheretima yunoshimensis* Hatai, 1930b: 655. Cf. its description above].

Amyntas hilgendorfi : Sims & Easton, 1972: 237 [partly in *tokioensis*-group, *youngi*-group (that is mistaken as *P. youngi* - a junior synonym of *A. glabrus*, actually has two pairs of spermathecae not just one pair) and partly in their *zebrus*-group]; Easton, 1981: 51 (appearing to accept Beddard’s 1900 synonymy of *rokugo*, *irregularis*, *schizopora* rather than Michaelsen’s synonymies).

Diagnoses of the various forms of this taxon from Michaelsen (1892, 1900) are: with spermathecal pores in 6/7 and/or 7/8 or 5/6/7/8; genital markings as presetal, central patches with numerous papillae (corresponding with internal pore-glands) in 8 and/or 9, and often in 17 and/or 18; intestinal caeca manicate.

Perichaeta glandularis was described by Goto & Hatai (1899: 18) with

spermathecal pores 6/7/8, markings in 7 and 17/18 and figured with male pores in copulatory pouches, but in other regards complies with Michaelsen's α morph.

The list of included species in the "*Amyntas hilgendorfi* species-complex" by Easton (1981) was fairly extensive and he appeared to accept the synonymies of *A. hilgendorfi* s. stricto by Beddard (1900) rather than those advocated by Michaelsen (1900). Studies by the current author have found specimens agreeing with *M. hilgendorfi* that have male pores (paired or single and sometimes displaced to segment 17 or 19) either in copulatory pouches or everted, and some other accounts (e.g. Ishizuka, 2000d; 2001) have morphs with male pores that appear in copulatory pouches and, if this is taken as the normal situation, then this taxon belongs in *Metaphire* rather than *Amyntas*.

Although Michaelsen (1900) had diagnosed this species with "*Prostates usually aborted, if present, similar to those of P. sieboldi, i.e. exiting directly without copulatory pouches*", *Metaphire sieboldi* was subsequently categorized as having copulatory pouches. Inexplicably, Ishizuka (1999a: 60) has both "*Perichaeta glandularis* : GOTO & HATAI, 1899" and "*Perichaeta rokugo* : BEDDARD, 1892" as **syn. n.**'s of *P. hilgendorfi* (Michaelsen, 1892) despite their earlier placings; and Ishizuka (1999a: 61) has both "*Perichaeta levis* GOTO & HATAI, 1899" and the prior "*Perichaeta schizopora* GOTO & HATAI, 1898" as **syn. n.**'s of *P. irregularis* (Goto & Hatai, 1899: 13) which he variously dates as either "1898" or "1899". In fact, Ohfuchi (1938a: 2; 1939: 81) had already combined *P. levis* (Goto & Hatai, 1899: 20) with *P. irregularis* (Goto & Hatai, 1899: 13) more than sixty years before. It is possible that the degraded morphs named *P. conjugata* by Ishizuka (1999b) are the same as *irregularis* as Ishizuka's figures of the deformed spermathecae are not much different to those shown in Ohfuchi (1938a: fig. 5) for his *P. koreana*. However, because *Perichaeta schizopora* and *P. irregularis* are such

degraded morphs, they could actually be attributed to several taxa with manicate intestinal caeca and, in my opinion, both are possibly in synonymy of *A. vittatus* and/or *A. tokioensis*.

[? *Metaphire levis* (Goto & Hatai, 1899) cf *A. tokioensis* above, this description in braces for clarity and comparison.

Perichaeta levis Goto & Hatai, 1899: 20, fig. 12 (of spermatheca and glands). From Takahashi and Kumamoto (Kyushu). Types missing (Reynolds & Cook, 1976).

Pheretima levis : Kobayashi, 1938: 129 fig. 7, from Korea; Gates, 1958: 21-24 (?syns. *irregularis*, *ambigua*, *vittata*, *schizopora*), from USA. Spermathecal pores in 6/7/8, genital markings paired in 8 and/or near spermathecal pores, male pores absent, caecae manicate - i.e., agreeing with current redescription of *A. tokioensis*.

Metaphire levis : Sims & Easton, 1972: 238 (*Metaphire glandularis* species-group).

Genus? *levis* : Easton, 1981: 51 (genus not stated within his "*Amyntas hilgendorfi* species-complex").

Diagnosis: Spermathecal pores in 6/7/8 surrounded by small papillae with glands internally; male pores and prostates typically aborted or vestigial - thus is is not known how Sims & Easton (1972) could reliably transfer this taxon to *Metaphire*.

Distribution: Japan, Korea (Kobayashi, 1938), and reported as introduced into North America by Gates (1958) and Easton (1981: 53) and from the Carolinas and Tennessee (where it is erroneously cited as "*Metaphire levis* (Horst, 1893)" - see <http://www.inhs.uiuc.edu/~mjwetz/AOGSMNP.PkChklst.html>) - possibly a

misidentification of a species that does have copulatory pouches. Recently reported from Bac and Nui Provinces of Vietnam.

Remarks: Possibly this species name is in synonymy of *M. hilgendorfi* as was indicated by Michaelsen (1900: 272) [cf. Easton (1981) who appears to have maintained them separately], and is provisionally retained herein as *Metaphire levis* although it too may actually belong in synonymy of *A. vittatus*, or as Ohfuchi (1938: 2) thought: a synonym of the *irregularis* synonym. My current opinion is that, since there is no reliable evidence that the male pores, when present, are invaginate, it is most likely yet another synonym of *A. tokioensis* wherewithin it is here included].

Metaphire servina (Hatai & Ohfuchi, 1937)

Pheretima servinus Hatai & Ohfuchi, 1937: 1. From many localities in NE Honshu. Types?
Metaphire servina : Sims & Easton, 1972: 238 (*Metaphire glandularis* species-group);
Easton, 1981: 59 (but he mistakes the spermathecae as in 6/7/8/9).

Diagnosis: Spermathecal pores in 6/7/8. Male pores within copulatory pouches on 18. Genital markings small, with large glandular masses internally, paired median to male pores equatorially on 18. Intestinal caeca manicate. Body usually less than 120 mm long. Distribution: Japan, (mainly northern Honshu).

Remarks: Easton (1981) mistakenly has *Metaphire servina* with three pairs of spermathecae in 6/7/8/9 while Sims & Easton (1972) place it in a group with only two pairs in 6/7/8 as in the original description. Ohfuchi (1937: 19) stated that his proposed *Pheretima hataii* resembled *Pheretima servinus* except for its three pairs of spermathecae as did his *P. gomejimensis* except for its lack of genital markings on 18. It is thus possible that these taxa are closely related and that *P. gomejimensis* is synonymous with *M. servina*. Two other taxa

that are possibly related are *A. tappensis* and *A. vittatus*, the latter having nomenclatural priority. This taxon is a new combination in the *M. hilgendorfi* group.

***Metaphire soulensis* (Kobayashi, 1938)**

Pheretima soulensis Kobayashi, 1938: 131, fig. 8. From Keiki-do and Keijo, Korea. Ten specimens. Types?

Pheretima shinkeiensis Kobayashi, 1938: 134, fig. 9. A specimen from Kokai-do - synonym as per Blakemore (2003: 43, addenda).

Metaphire soulensis : Sims & Easton, 1972: 238 (*Metaphire glandularis* - group); Blakemore, 2003a: 43 (syns. *Pheretima shinkeiensis* Kobayashi, 1938, *Pheretima aokii* Ishizuka, 1999; held as *species incertae sedis*).

Pheretima aokii Ishizuka, 1999b: 36; Ishizuka *et al.*, 2000b: 180. - synonym as per Blakemore (2003: 43, addenda).

?*Amyntas dageletensis* Hong & Kim [2005: 129](#). From Korea. ?**Syn. nov.**

Distribution: Korea and Japan.

Remarks: Parthenogenetically degraded morphs 50-125 mm long described with adiverticulate spermathecae in 6/7/8 (sometimes lacking?), and (always?) lacking prostate glands and male pores but with genital markings as clusters of two or more papillae on 18 that have corresponding glands internally in the usual position of the male pores. These papillae, when fully formed, are at least partly retractable into the body (hence = *Metaphire*). Intestinal caeca manicate. Specimens have also been found at Kuzuharagaoka Shrine, Kamakura, Japan (several specimens collected 13.vi.2004 by RJB, Amanda Reid and Yuko Hiramoto) that agree superficially although they lack male pores and markings, but have an extra pair of spermathecae in 5/6 (cf. the smaller *P. kamakurensis*).

Easton's (1981: 6) synonymy in *M. yamadai* (Hatai, 1930) of *M. soulensis* (Kobayashi, 1938) is not accepted here due to differences in markings around the male pores.

Specimens with or without copulatory pouches are included because an almost continuous series may be thus found: from degraded morphs that only have a few superficial markings on 18 [for example, male sterile morphs such as *Amyntas shinkeiensis* (Kobayashi, 1938) sensu Sims & Easton (1972: 245)], to those with many markings on an invaginated disc on 18 [for example, male sterile morphs such as *Metaphire soulensis* (Kobayashi, 1938) sensu Sims & Easton (1972: 238)]. Kobayashi's (1938: fig. 8) of *P. soulensis* is essentially the same as Ishizuka's (2000e: figs. 9-16) of the holotype of *P. aokii*, and Kobayashi's (1938: fig. 9) of *P. shikeiensis* is again similar to Ishizuka's (2000e: figs. 17-18) of a paratype of *P. aokii*. In Ishizuka *et al.* (2000b: 180) the distribution of *P. aokii* is claimed to include Korea, but this is without obvious justification although, by applying the principle of priority, if it were synonymous with *M. soulensis* then the range of this latter taxon would now extend to Japan. In actuality, the biogeographic value of these parthenogenetic events is often open to discussion.

Metaphire vesiculata (Goto & Hatai, 1899)

Perichaeta vesiculata Goto & Hatai, 1899: 21, figs. 13-15. From Takahashi (Okayama-ken) and Oarai (Ibaraki-ken). Types?

Pheretima vesiculata : Michaelsen, 1900: 312.

Metaphire vesiculata : Sims & Easton, 1972: 238 (*Metaphire glandularis* species-group).

[? *Pheretima köllikeri* Michaelsen, 1928 : 8, figs. 1, 2 (et *P. koellikeri*). From "Japan".]

? *Pheretima okutamaensis* Ishizuka, 1999b: 38.

?*Pheretima biggiberosa* Ishizuka, 1999b: 38.

Diagnosis: Spermathecal pores in 6/7/8. Male pores within copulatory pouches on 18 (with secretory diverticula internally). Genital markings absent. Intestinal caeca manicate. (Nephridia absent from spermathecal ducts). Cf. *D. schmardae* with spermathecal pores in 7/8/9.

Distribution: Japan (and Korea?).

Remarks: Easton (1981: 60) tentatively included *Pheretima vesiculata* Goto & Hatai, 1899 in synonymy of *Pheretima (Parapheretima) koellikeri* (Michaelson, 1928), but *P. vesiculata* has priority. Sims & Easton (1972: 238) have *Metaphire vesiculata* in a *Metaphire glandularis* species-group [other stated members were *glandularis* (Goto & Hatai, 1899), *levis* (Goto & Hatai, 1899), *servinus* (sic) (Hatai & Ohfuchi, 1937), and *soulensis* (Kobayashi, 1938)]. In this current revision, *Pheretima koellikeri* is removed from synonymy and returned to its probable genus *Metaphire*.

Ishizuka (1999a: 65) has *P. vesiculata* (with spermathecae in 6/7/8) as "**syn. n.**" of *Duplodidodrilus schmardae* (with spermathecae in 7/8/9) although this was already claimed by Beddard (1900a: 619), and Ishizuka (1999b) described *Pheretima okutamaensis* and its synonym *P. biggiberosa* with spermathecae in 6/7/8 and male pores in copulatory pouches (everted during preservation in *biggiberosa*?) with secretory diverticula internally. However, no mention of nephridia on the spermathecal ducts was made nor were any shown in figures, therefore these two names are provisionally placed under *Metaphire vesiculata* pending further resolution. Affinities may be with the *M. hilgendorfi* species complex into which this taxon is newly accommodated herein, or possibly with *Metaphire soulensis*.

Metaphire yamadai (Hatai, 1930)

Pheretima yamadai Hatai, 1930b: 664, fig. 8. From Tottori, Okayama, Wakayama, Kobe and Hata (Ishikawa-ken). Types unknown.

?*Pheretima pectinifera* Michaelsen, 1931: 15. From Soochow.

Pheretima yamadai: Gates, 1935: 13-14 (?syn. *pectinifera*; non *yamadai*: Chen, 1933: 255, figs. 20-21); Gates, 1936: 272 (syn. ?*pectinifera*).

Amyntas yamadai: Sims & Easton, 1972: 237 (*Amyntas sieboldi*-species group).

Metaphire yamardai: (sic lapsus pro *yamadai*) Easton, 1981: 60 (syn. *soulensis* - but this not accepted here, see *M. soulensis* below); Blakemore, 2003: 43, addenda.

Diagnosis: Length up to 127 mm (cf. 210 mm *pectinifera*). Spermathecal pores in 6/7/8/9. Male pores within copulatory pouches occupying 17/18-18/19. Genital markings small, median to spermathecal pores on 7 and 8 and within copulatory pouches (*pectenifera* has additional markings in several longitudinal ranks median to level of spermathecal pores in 7-9). Intestinal caeca manicate (or the exact quote: "in XXVIII the finger shaped coeca [sic] with five projections are found in pairs"); [Chen (1933:255-261, fig. 21) has "caeca lobulated in 27-24 or 23(22), with parallel lobes or vertically tooth-shaped diverticula" but this was a misdescription according to Gates (1948: 13)].

Distribution: Japan, China, ?Korea (Easton, 1981: 60 states "Japan, China, Korea", but Korea is probably just for his *soulensis* synonym; whereas Kobayashi (1939) just claims *yamadai* in Japan and China).

Remarks: Some accounts (erroneously?) have spermathecal pores in 5/6/7/8 despite them being described as in 6/7/8/9. This taxon is a new combination in the *M. hilgendorfi* species complex. *M. yamadai* (Hatai, 1930) is almost exactly similar superficially to *M. aggera* (Kobayashi, 1934) that differs in its simple but incised intestinal caeca (?unless

these were misdiagnosed in *M. yamadai*), and Kobayashi (1938a: 155, 157) says that his *P. aggera* is close to, and may be synonymous with, *Amyntas tschiliensis* (Michaelson, 1928), its synonym *Metaphire kiangsuensis* (Chen, 1930) from Chen (1933: 250), and with his own *Metaphire quelparta* (Kobayashi, 1937). *M. quelparta* is almost exactly the same in each described character except for its large saccar bodies associated with the spermathecal pores, but it may belong in synonymy nevertheless. For Chinese *M. yamadai*, Chen (1933: 259, fig. 21) shows variations with the caeca either deeply incised or manicate, but this was a misdescription by Chen of a composite of both Michaelson's *P. pectenifera* and *P. tschiliensis*.

If *M. yamadai* is misinterpreted and in acutality has incised caeca, then its synonymy may include *M. quelparta* (Kobayashi, 1937), *M. sanseiana* (Hatai, 1951: 56) and the probable **syn. nov.** of the latter species, *M. indigo* (Hatai, 1951: 58).

Easton's inclusion of *Metaphire soulensis* in synonymy of *M. yamadai* is not supported, as there are notable differences in morphology, especially of the markings around the male pores. Thus, *M. soulensis* is maintained separately and described below with *shinkeiensis* Kobayashi, 1938 and Ishizuka's *P. aokii* included as junior synonyms.

[[End of *Metaphire hilgendorfi* / *Amyntas tokioensis* species-complex]].

Metaphire megascolidioides (Goto & Hatai, 1899)

Perichaeta megascolidioides Goto & Hatai, 1899: 21, fig. 16. From within the compound of the then Central Metereological Observatory (= Metereological Agency), Akasaka,

Tokyo. Types?

Pheretima megascolidioides : Michaelsen, 1900: 283; : Ishizuka, 2001: 94, figs, 1-10 (some figures inadvertently inverted).

Amyntas megascolidioides : Sims & Easton, 1972: 236; Easton, 1981: 54.

Diagnosis: Spermathecal pores in 4/5/6/7/8/9. Male pores in slight copulatory pouches on segment 19. Genital markings small paired in line with male pores on 17, 18, 20 and sometimes 21. Metandric. Intestinal caeca manicate main sac with additional appendages (= multiple).

Distribution: Japan and Korea.

Remarks: Michaelsen (1900) repeated Goto & Hatai's statement that the intestinal caeca were paired, thus Easton (1981) had them as simple; Ishizuka (2001: 94) figures them as multiple, and inspection of newly collected material confirms this latter condition. These plus five pairs of spermathecae and male pores on 19 are characteristic. The male pores are on the tips of small eversible penes that are usually withdrawn in copulatory pouches (pers. obs.), thereby qualifying this taxon for inclusion in *Metaphire*. It is worrying that the original authors had only a single specimens and could not distinguish its manicate caeca, thus casting into doubt some of their other descriptions. This species is particularly common in parklands around Kamakura, including road-side drains at Kuzuharagaoka Shrine and under rocks inside the grounds of the Kotokuin (Daibutsu) Temple (pers. obs.).

Metaphire parvula (Ohfuchi, 1956)

Pheretima parvula Ohfuchi, 1956: 152 [non *Perichaeta parvula* Goto & Hatai, 1898: 68 (?= *Amyntas gracilis*); nec *Pheretima parvula* Ishizuka, et al., 2000b (= '*Pheretima*' *parvula* Blakemore **nom. nov.**)]. From Sonai, Iriomote-jima. Types?

Metaphire parvula : Sims & Easton, 1972: 239 (*M. planata* group); Easton, 1981: 58.

Pheretima mediparvula : Nakamura, 1999: 2 nom. nov. pro *Pheretima parvula* Ohfuchi (non Goto & Hatai). [Under ICZN (1999: Art. 59.4) a secondary junior homonymy replacement name can be retained as a junior synonym, but see notes below].

Diagnosis: Spermathecal pores in 6/7/8. Male pores within copulatory pouches on segment 18. Genital markings absent. Intestinal caeca simple.

Distribution: Japan (Sonai, Iromote-jima, Ryukus).

Remarks: Sims & Easton (1972: 224; 239) have this species in a *Metaphire planata* (Gates, 1926) species-group and note: *Pheretima parvula* Ohfuchi, 1956: 152 [non *Perichaeta parvula* Goto & Hatai, 1898 (= *species incertae sedis*)], whereas Easton (1981) placed Goto & Hatai's taxon in unlikely synonymy of *Amyntas gracilis*. In disregard of all this, Ishizuka (1999a: 63) proposed "*Pheretima* OHFUCHI, 1956 nom. n." [sic] as a replacement name for *Metaphire parvula*, but this formulation is invalid (e.g. under ICZN 1999: Art. 11.2). In a later publication, Nakamura (1999b: 2, 28) similarly proposed the unnecessary name "*Pheretima mediparvula* nom. nov." for *Pheretima parvula* Ohfuchi, 1956, believing it to be a secondary homonym. Next, Ishizuka (2000c: 76) in a nonsense sentence has "*Ph. Ohfuchi*" [sic] that is yet possibly a mistake for some other taxon, and later Ishizuka (2001: 101) cites "*P. ohbuchii* **nom. n.**" [sic] as an invalid *nomen nudum* and/or *nomen dubium* which possibly is also supposed to refer to this taxon. Whereas the former editions of the Code had expressly excluded junior synonyms from entering into homonymy (thereby possibly invalidating Ishizuka's and Nakamura's actions) these were permitted under ICZN (1999: 59.1, that took effect after 1st January, 2000); however, under ICZN (1999: Art. 59.4) the original Ohfuchi name is reinstated. Further confusion from application of the name "*Pheretima parvula*" recently proposed

for degraded parthenogenetic morphs by Ishizuka et al. (2000b: 186) is resolved herein by provision of a new replacement name for them: *Pheretima palarva* Blakemore **nom. nov.**

Metaphire peguana (Rosa, 1890)

Perichaeta peguana Rosa, 1890:113, figs. 6-8. Type locality Rangoon. Types in Genoa.

Amyntas peguanus [sic] : Michaelsen, 1899:7.

Pheretima peguana : Michaelsen, 1900: 292; Gates, 1972: 207 (syn. *saigonensis*).

Pheretima saigonensis Omodeo, 1957: 327. Type locality Saigon. Types in Verona?

Metaphire peguana, Sims & Easton, 1972:239 (*peguana-group*); Easton, 1981: 58.

Diagnosis: Spermathecal pores in 6/7/8/9. Male pores within copulatory pouches on segment 18. Genital markings large paired in segment 17/18 and 18/19. Intestinal caeca simple.

Distribution: South-east Asia (and Okinawa, Japan?).

Remarks: Gates (1972: 208-209) questions the true identity of the Ryukyu Island's record for this species by Ohfuchi (1956), although Easton (1981) lists it on the justification that the correct assignment to a species was not made. It is an unconfirmed Japanese record.

Metaphire riukiensis (Ohfuchi, 1957)

Pheretima riukiensis Ohfuchi, 1957: 248, fig. 21. From Ryukus. Types?

Metaphire riukiensis : Sims & Easton, 1972: 238; Easton, 1981: 58.

Diagnosis: Spermathecal pores in 5/6/7/8/9. Male pores within copulatory pouches (or seminal grooves?) occupying 17-19. Genital markings absent. Intestinal caeca simple with incised margins.

Distribution: Ryukyu Islands.

Remarks: Easton (1981:48, 58) states that it is not certain whether *Metaphire riukiensis* has male pores in copulatory pouches (= *Metaphire*) or in seminal grooves (= *Amyntas*). Sims & Easton (1972) have this species in a *Metaphire ignobilis* species-group implying their earlier acceptance of the former state.

***Metaphire sieboldi* (Horst, 1883)**

Megascolex sieboldi Horst, 1883: 191. From "Japan". Types in Leiden: 1825.

Perichaeta sieboldii : Rosa, 1891: 401; Horst, 1898; [non *Perichaeta sieboldii* : Goto & Hatai, 1898:65 (= *Metaphire communissima*), ? nec *Perichaeta sieboldi* : Beddard, 1892b: 759 (possibly part of *hilgendorfi* complex)].

Perichaeta siboldi [sic lapsus]: Michaelsen, 1892: 235.

Amyntas sieboldi [sic]: Michaelsen, 1899: 4.

Pheretima sieboldi : Michaelsen, 1900: 304 [non Goto & Hatai, (1898), 1899; syn. *P. sieboldi* : Beddard, 1892b: 759 (cf. *M. communissima*)]; Hatai, 1931: 397 (description of two specimens from Kochi, Shikoku?).

Pheretima setosa Cognetti, 1908: 1, fig. 1 [non *Pheretima setosa* Ishizuka et al., 2000b (= *A. corticis*)]. From Tokushima-ken, Shikoku. Types in British Museum: 1908:1.29-31.

Amyntas sieboldi : Sims & Easton, 1976: 213, 237.

Metaphire sieboldi : Easton, 1981: 59 [syn. *setosa*; Easton also notes: *sieboldi* Horst, 1883 non Goto & Hatai, 1898: 65; nec Beddard, 1892b: 759 (= *Metaphire communissima*, a part of the *Metaphire hilgendorfi* species-complex)].

Diagnosis: Large blue species (up to 270 mm long by 10 mm wide). Spermathecal pores in 6/7/8/9. Male pores within shallow copulatory pouches on segment 18. Genital

markings absent. Intestinal caeca manicate.

Distribution: Japan.

Remarks: This was the first species formally described from Japan. Sims & Easton (1972: 237) have this species in an *Amyntas sieboldi* species-group although its male pores in copulatory pouches qualify it for inclusion in *Metaphire* as per Easton (1981). The diagnosis of the *M. hilgendorfi* complex would encompass this species, yet its distinctive blue colour, at least in matures, serves to separate it. Specimens recently collected by the author from around Kochi, Shikoku where it is common in natural woodlands.

Metaphire tosaensis (Ohfuchi, 1938)

Pheretima tosaensis Ohfuchi, 1938c: 58, figs. 3-5. From a cave entrance at Tosa. Types?

Metaphire tosaensis : Easton, 1981: 59.

Diagnosis: Spermathecal pores in 5/6/7/8/9. Male pores within copulatory pouches on 18.

Genital markings absent. Intestinal caeca simple with slightly incised margins.

Distribution: Shikoku, Japan.

Genus *Pheretima* Kinberg, 1867

Type species: *Pheretima montana* Kinberg, 1867: 102 [non Ishizuka, 1999c] from Tahiti.

Taxonomic note: The genus *Amyntas* has page priority over *Pheretima* in Kinberg, 1867 (two other of Kinberg's genera names, *Nitocris* and *Rhodopis*, were preoccupied).

However, the prior *Perichaeta* Schmarda, 1861 is still an available name despite disuse after 1899 through its synonymy with *Megascolex* Templeton, 1855 (see Michaelsen, 1900; Sims & Easton, 1972: 175-176; Blakemore, 2002). Reviews by Nakamura (1999b)

and Ishizuka (1999a, 2000c, 2001) should have considered such points before reverting to the use of *Pheretima* in preference to *Amyntas* and/or *Metaphire*.

Diagnosis: Pheretimoids with intestinal caeca near 27; male pores in copulatory pouches; nephridia present on the spermathecal ducts.

Distribution: Endemic in the Malaysian sub-region to New Guinea. Japan is not now considered part of the range (see below); some species peregrine, but not confirmed from Japan.

Remarks: Sims & Easton (1972), allowed only species complying with the characteristics of the type-species, i.e., having nephridia on the spermathecal ducts, are placed under *Pheretima*. The generic allocation of degraded morphs lacking spermathecae and/or male pores cannot easily be determined. Two subgenera are included: Subgenus *Pheretima* Kinberg, 1867 with type species *Pheretima (Pheretima) montana* (Kinberg, 1867) from Tahiti; and subgenus *Parapheretima* Cognetti, 1912 with type species *Pheretima (Parapheretima) aberrans* (Cognetti, 1911) from New Guinea. These two subgenera are separated on absence or presence of secretory diverticula on the copulatory pouches, and are distributed in Indonesia/Malaysia and Borneo/New Guinea, respectively. Synonymy of *Pheretima (Parapheretima) koellikeri* (Michaelsen, 1928) with *Metaphire vesiculata* by Easton (1981) and Blakemore (2003) had previously removed this genus from the Japanese list due to priority, but it is herein restored to ?*Metaphire* with provisos noted below.

?Metaphire koellikeri (Michaelsen, 1928)

[Fig 6.](#) of male pore and a spermatheca from Michaelsen (1928: figs. 1, 2).

Pheretima sp. (Köllikeri) (sic - nomen nudum) Michaelsen, 1903: 100.

?*Pheretima köllikeri* Michaelsen, 1928 : 8, figs. 1, 2 (et *P. koellikeri*). From "Japan". Types possibly in Hamburg although collector A. v. Kölliker was from Munich Museum.

Pheretima (*Parapheretima*) *koellikeri* : Easton, 1981: 60 (syn. *Pheretima* sp. Michaelsen, 1903, ?*vesiculata*); Blakemore, 2005.

Distribution: "Japan", Sims & Easton (1972: 221) thought it possibly introduced.

Description (from Michaelsen): Length 148-164mm by 8-9mm with 100 segments. Setae 37-57. First dorsal pore 12/13. Male pore on penes invaginated within large porophores on 18 but extending across intersegmental furrows. Spermathecal pores in 6/7/8. Genital markings absent. Intestinal caeca manicate. Holandric. Prostates racemose in 17-22 ducting to penis. Copulatory pouches confined to body wall with accessory secretory diverticula opening anterior to male pores and associated with penial setae. These diverticula resemble tubular prostates and extend to segments 17 or 16. Spermathecal diverticula zig-zag (nephridia not noted on ducts).

Remarks: Easton's synonymy of *Pheretima koellikeri* with *Metaphire vesiculata* had assumed this species lacked nephridia on the spermathecal ducts (Michaelsen's figure 2 does not show any) and that *M. vesiculata* lacked them too (but had secretory glands?). However, Goto & Hatai (1899: fig. 15) did not show any such glands for their *P. vesiculata* and, moreover, a characteristic of *Metaphire* is having stalked glands, rather than secretory diverticula, on the copulatory pouches (Sims & Easton, 1972: 215, 221).

Sims & Easton (1972: 222) only provisionally placed *koellikeri* in the subgenus *Pheretima* (*Parapheretima*) because Michaelsen (1928:11) had remarked on its similarity to other members that also had secretory diverticula on their copulatory pouches; confirmation of presence of nephridia on the spermathecal diverticula is required for

membership (and Michaelsen's figure, reproduced here does not show them), thus this species is provisionally placed in *Metaphire* but may require allocation to another, possibly new, genus.

Genus *Pithemera* Sims & Easton, 1972

Type species and locality: *Perichaeta bicincta* Perrier, 1875 from the Philippines.

Diagnosis: Pheretimooids with superficial male pores and intestinal caeca paired (sometimes a mid-ventral caecum) in or near segment 22 (rarely 24).

Distribution: Mostly Oceania, the type-species cosmopolitan by introduction.

Pithemera bicincta (Perrier, 1875)

Perichaeta bicincta Perrier, 1875 : 1044. From Philippines. Types in Paris Museum.

?*Perichaeta violacea* Beddard, 1895: 407 (= *Pheretima*, *Amyntas*). From Penang.

Syntypes (Sims & Easton, 1972: 181) British Museum 1904:10.5.185/187 [Non *Perionyx violaceus* Horst, 1893].

?*Pheretima aimerikiensis* Ohfuchi, 1941: 302, fig. VIII. From Aimeriki, Palao - synonym as per Blakemore (2003: 43, addenda).

Pithemera bicincta : Sims & Easton, 1972: 202 (?syn. *violacea*); Lee, 1981: 563; Easton, 1981: 60.

Diagnosis: Spermathecal pores in 4/5/6/7/8/9. Male pores superficial on 18. Genital markings large, paired median to male pores and extending into 17 and 19. Intestinal caeca simple originating in 22.

Distribution: Widely distributed species also recorded from Japan (Ryukus).

Genus *Polypheretima* Michaelsen, 1934

Type species: *Perichaeta stelleri* Michaelsen, 1892.

Diagnosis: Pheretimoids with male pores superficial or in copulatory pouches; intestinal caeca absent.

Distribution: Endemic to Vietnam, Malaysia, Indonesia and New Guinea regions; a few species peregrine. With the removal of *Polypheretima iizukai* (Goto & Hatai, 1899) to synonymy of *Amyntas fuscatus*, the genus is no longer considered indigenous to Japan.

Sims & Easton (1972: 252) and Easton (1976) established an informal species complex for taxa related to *Metapheretima elongata* (= *Polypheretima elongata*).

Polypheretima elongata (Perrier, 1872)

Perichaeta elongata Perrier, 1872 : 124. From Peru. Types in Paris Museum: 633-644.

Perichaeta biserialis Perrier, 1875: 1044; Beddard, 1889:63, figs. 4, 7; Michaelsen, 1900: 256 (syn. *acystis*, *monocystis*); Ishizuka, 2001: 100 (misspelt "bicerialis"). Types in Paris: 635-644 [despite overlap, both sets of Paris Museum specimen numbers are from Reynolds & Cook (1976)].

Megascolex elongata : Vaillant, 1889: 81.

Perichaeta acystis Beddard, 1895: 423 [nom. nov. pro *biserialis* : Beddard, 1890 (non Perrier, 1872)]. Types in British Museum: 1904:10:5:1-2.

Perichaeta monocystis Horst, 1899: 202 (lapsus pro *acystis* Beddard, 1895).

Amyntas elongata : Beddard, 1900: 650.

Pheretima elongata : Michaelsen, 1900: 265; Gates, 1972: 182 [syn. *aelongata* Gates, 1926: 444 (misspelling); non *elongata* : Ohfuchi, 1956:148 (= *A. morrissi*)].

Pheretima aelongata Gates, 1926: 444 (misspelling or illegal emendation).

Metapheretima elongata : Sims & Easton, 1972: 205 (syn. *biserialis*): Easton, 1976: 40.

Polypheretima elongata : Easton, 1979: 53 (syn. *biserialis*); Easton, 1981: 61 [syn.

biserialis; non *elongata* : Ohfuchi, 1956 (= *Amyntas morrisi*)].

Diagnosis: Spermathecal pores absent or multiple in 5/6 or 6/7 or 5/6/7. Male pores in copulatory pouches on 18. Genital markings large, paired in line with male pores on 19-24. Intestinal caeca absent.

Distribution: Indigenous range Java, Bali, and Lombok, but widely distributed in other regions by introduction. For full distributions and synonymy, see Sims & Easton (1972: 252); Easton (1976; 1979); and Blakemore (2002).

Remarks: Gates (1972: 183) remarked that the specimens identified by Ohfuchi (1956: 148) as *P. elongata* were mistaken and that other specimens referred to *P. biserialis* by Ohfuchi (1956: 151) were more likely to have been *P. elongata*. Easton (1981: 61) and Shih *et al.* (1999: 438) attribute Ohfuchi's (1956: 148) specimens to *Amyntas morrisi*. In ignorance of these misidentifications and of taxonomic protocol, Ishizuka (1999a: 63; 2001: 101) has the prior and valid *Perichaeta elongata* Perrier, 1872 as “**syn. n.**” of *Pheretima morrisi* (Beddard, 1892). This action can be ignored.

Family Glossoscolecidae

[See Blakemore (2002) for family/genus details].

Pontoscolex corethrurus (Müller, 1857)

Lumbricus corethrurus Fritz Müller, 1857: 113. [Type locality Itajahy, Brazil. Types not located]. [Note: date and page sometimes miscited as "1856: 26"].

Urochaeta hystrix Perrier, 1872: 142.

Urochaeta corethrura: Perrier, 1874: 379.

Pontoscolex arenicola Schmarda, 1861: 11 (part, type), fig. 157 (<http://biodiversity.uno.edu/~worms/docs/schmarda.html>); Beddard, 1892: 126, figs. 3 and 6. [Note: Schmarda (1861) confused two species under the same name without giving a type specimen although his figure (fig. 157) was the same as the specimen that Beddard (1892: 126, figs. 3, 6) separated as *Pontoscolex arenicola* (= *Pontoscolex corethrurus*), the other he named *Diachaeta littoralis* Beddard, 1892. From tidal beaches Port Royal, Jamaica; "arenicola" or "harenicola" translates as "sand or beach-loving or dwelling". Types in Vienna Museum.

Urochaeta dubia Horst, 1885: 7. [Type locality Sumatra].

Urochaeta, sp. Beddard, 1887: 160, Pl V, figs. 4-9 (= *P. corethrurus*), [From Queensland].

Urochaeta australiensis Beddard, 1891: 278.

Pontoscolex hawaiiensis Beddard, 1896: 186 (sometimes misquoted as "Beddard, 1895: 660"). From Hawaii.

Pontoscolex corethrurus mexicana Eisen, 1896: 8.

Pontoscolex corethrurus: Beddard, 1892b: 127; Michaelsen, 1900: 425 (syn. *mexicana*, *hystrix*, *dubia*, *australiensis*, *hawaiiensis*); Stephenson, 1916; Gates, 1972: 53-58 (syn. *arenicola*); Sims & Gerard, 1895, 1999: 124, fig. 44; Lee, 1981: 568; Easton, 1984: 120.

Diagnosis: Body pigmentless; clitellum pale or yellow saddle shaped in 15-22,23. Setae 8 per segment; in the posterior part of the body in quincunx (alternating regularly from segment to segment). Three pairs of calciferous glands visible through the cuticle in front of clitellum. Prostomium forms "proboscis". Spermathecal pores at 6/7-8/9. Female and male pores difficult to locate (in 14/15 and 19/20 or 20/21, respectively). [Full description in Blakemore (2002)].

Distribution: Pan-tropical; supposedly "the most widely distributed earthworm" (Gates, 1972: 55); classed as geophagous, endogeic, eurytopic (and euryhaline?); its common occurrence in coastal areas suggests marine transportation (by drifting?), its close association with rivers also indicates a possible mechanism of transportation (of cocoons). Human mediated transportation is probably also important. Full distribution is given in Blakemore (2002). Japanese records are from Yona, northern Okinawa, (collected by R.J.B on 20.xi.2005 from soil by drain in *Castanopsis sieboldii* forested hills above Ryukyu Univeristy Forestry Research Centre). **New record for Okinawa/Japan** [not known from mainland Japan although Nakamura (1994) reports it from Ogasawara (= Bonin Islands)].

Species incertae sedis i.e., species names "of uncertain taxonomic position" - ICZN (1999: 106, Glossary).

Most parthenogenetically degraded morphs, precipitously given species names that remain available pending synonymy or unification with their biparental/ancestral forms.

Amyntas hibernus (Ishizuka, 1999)

Pheretima hiberna Ishizuka, 1999d: 233 [misspelt "hiverna" in Ishizuka, 2001: 101].

Diagnosis: Monotypic; based on a single degraded morph with defective spermathecae in 7/8/9; superficial male pores; genital markings absent; prostate glands absent; and intestinal caeca simple.

Remarks: The male organs and spermathecae would presumably differ in 'normal' amphimixic specimens and this degraded morph is possibly merely part of the inadequately described *A. imperfectus* which itself may actually comprise more than one taxon.

Amyntas illotus species-group sensu Sims & Easton (1972).

Amyntas illotus species-group Sims & Easton, 1972: 236 [included names: *ambiguus* (Cognetti, 1906: 782) (non Cognetti, 1913); *assacceus* (Chen, 1938); *illotus* (Gates, 1932); *irregularis* (Goto & Hatai, 1899); *pusillus* (Ohfuchi, 1956) (non Ude, 1893); *sheni* (Chen, 1935); *Metaphire varians* (Chen, 1938) (part, non type – other components of this hodge-podge had spermathecal pores in 5/6, or 5/6/7)]; Easton, 1981: 53 [included Japanese names: *illota*: Ohfuchi, 1956, (non Gates, 1932); *pusilla* Ohfuchi, 1956 (non Ude, 1893); *oyuensis* Ohfuchi, 1937].

Diagnosis: Spermathecal pores absent (at least in designated holotypes?) i.e., athecate parthenogenetic morphs. Male pores superficial (?or absent). Intestinal caeca simple. Gates's original two *illotus* specimens were 150-160 by 5-6 mm size with 120 segments. Ohfuchi's specimens were 125-155 mm with 125-144 segments; *A. assacceus* is in the size range 30-80 mm long; and '*Pheretima*' *oyuensis* is perhaps smaller, about 50-55 mm with 75-93 segments.

Remarks: In anticipation of synonymy with thecate species once additional data become available, Easton (1981: 53) maintained these degraded morphs under an *Amyntas illotus* species-group, rather than listing them partly as *incertae sedis* as per Sims & Easton (1972: 223) and as listed herein. For convenience, Easton's list had three Japanese 'species': *Amyntas* '*illotus*' sensu Ohfuchi (1956:136) (non Gates, 1932: 397); *A. pusillus* (Ohfuchi, 1956) [now placed in synonymy with *Amyntas assacceus* (Chen, 1938)]; and '*Pheretima*' *oyuensis* Ohfuchi, 1957; to which we can add yet other unresolved degraded morphs named *Pheretima imperfecta* by Ishizuka (1999d). Remaining members of the *A. illotus* species-group from other than Japanese reports are *Amyntas assacceus* (syn. *pusillus* : Ohfuchi, 1956, ?*proasacceus* Tsai *et al.*, 2001); *A. catenus* Tsai *et al.*, 2001 from Taiwan; *A.*

hohuanmontis Tsai *et al.*, 2002 from Taiwan; and *A. sheni* (Chen, 1935) from Hong Kong (but cf. *A. corticis* or *A. robustus*).

Amyntas illotus species-group included species names reported from Japan:-

Amyntas assacceus (Chen, 1938)

Pheretima assacceus Chen, 1938: 382. From Hainan Island. Types?

Amyntas assacceus : Sims & Easton, 1972: 236 (*A. illotus* species-group).

Amyntas asacceus [sic, lapsus]: Tsai *et al.*, 2001: 284 [syn. *pusilla* Ohfuchi, 1956 (non Ude)].

Pheretima medipusilla Nakamura, 1999b: 2 nom. nov. pro *Pheretima pusilla* Ohfuchi, 1956: 138 [non *Perichaeta pusilla* Ude, 1893 (= *Amyntas minimus*)]. [Nakamura (1999b:2) had proposed the then unnecessary replacement name *Pheretima medipusilla* for Ohfuchi's name and, although in former editions of the Code junior synonyms had been expressly excluded from entering into homonymy, under ICZN (1999: Arts. 59.1; 60.3) which came into effect on 1st January, 2000, replacement of a secondary junior homonym without known synonyms is accepted as a valid nomenclatural act, albeit Tsai *et al.* (2001: 284; 2002) later found a synonym. Thus, if Nakamura's *pusilla* belongs in *Amyntas* whence Ude's *pusilla* resides, then for a brief period Nakamura's replacement name perhaps was valid and so it remains available (ICZN, 1999: Art. 10.6)]. From Iriomote-jima, Sakishima, Ryukyus. Type unknown.

?*Amyntas proasacceus* Tsai *et al.*, 2001: 282 [sic]. From Taiwan.

Diagnosis of *Amyntas assacceus*: Morphs variously degraded parthenogenetically; either lacking spermathecae (types), or having them intermittently in some or all of 6-8; male

pores superficial on large flat porophores on 18, or aborted; intestinal caeca simple. Size range, ca. 30-80 mm long (cf. *A. minimus*).

Distribution: Hainan, Taiwan, Ryukyus.

Remarks: Nakamura (1999b: 2, 20) proposed the replacement name "*Pheretima medipusilla*" for the name cited in Easton (1981: 54) as *Amyntas pusillus* (Ohfuchi, 1956), while Ishizuka (2000c; 2001) appears to have completely overlooked the conflicts in these names. The specimens described as *A. proasacceus* were thought by Tsai *et al.* (2001: 285) to be closely related to the ancestral forms of *A. assacceus* and are consequently placed in provisional synonymy of this prior taxon which, nevertheless, retains its *incertae sedis* status, at least in the Japanese fauna. A possibly similar taxon is *Perichaeta parvula* Goto & Hatai, 1898 from Kamakura described on a specimen that was small (32 mm) with adiverticulate spermathecae in 6-8 and that lacked male pores and genital markings.

Amyntas illotus (Gates, 1932).

Pheretima illota Gates, 1932: 397; 1972: 196 (?syn. *youngi* Gates, 1932: 406). Type locality To Noi, Mong Lem State, Yunnan, China (not Myanmar). Types, missing.

?*Pheretima youngi* Gates, 1932: 406. Type locality Pang Wo, Myanmar. Types in ZSI, Calcutta 3077 (Reynolds & Cook, 1976: 191).

?(*Pheretima illota* : Ohfuchi, 1956: 136 (non Gates, 1932: 397). [Misidentification].

From Ishigaki and Iriomote Islands (Ibaruma, Hatoma-jima, Hoshidate)).

Amyntas 'illotus' : Easton, 1981: 53.

Remarks: The diagnosis of *Amyntas illotus* (Gates, 1932: 397) was restricted by Gates (1972: 196) to exclude the Japanese specimens identified by Ohfuchi (1956), but no alternative was provided, and Easton (1981) believed that a new name was not warranted for

these parthenogenetically degraded morphs. Gates (1972: 196) also surmized that his subsequent *Amyntas youngi* (Gates, 1932: 406) (with types either lost or in Calcutta Museum: 3077) may be one possible candidate for his species's H morph, although information was lacking for confirmation of this. Tsai *et al.* (2002) give distribution of *A. illotus* as Yunnan (China) and Ishigaki Island, apparently accepting Ohfuchi's records, even though the diagnosis of these latter specimens differed considerably from Gates's original. Thus it is an unlikely Japanese record.

Amyntas imperfectus (Ishizuka, 1999)

Pheretima imperfecta Ishizuka, 1999d: 229.

Remarks: Described as either lacking spermathecae (holotype?), or having them adiverticulate in 5/6 (one side), or 7/8 (one side); genital markings absent; caeca simple; size range 49-92 mm. The condition in the holotype is not explicitly stated and this name may be a 'grab bag' of degraded morphs of more than one unresolved species. Parts are possibly in synonymy with '*Pheretima*' *oyuensis* if, as Ishizuka states, they are distinguishable from this by the presence of male pores and occasional spermathecal pores (see also *A. hibernus*, *A. minimus*, *P. oyuensis*, *P. palarva*).

[?*Metaphire varians* (Chen, 1938).

Pheretima (*Pheretima*) *variens* Chen, 1938: 385. From Hainan. Types?

Amyntas variens (sic lapsus pro *variens*): Sims & Easton, 1972: 236.

Remarks: Male pores, spermathecae and genital markings sometimes absent. Atheal (?not primary type) components are unlikely to be in the *A. illotus* species-group; other components had spermathecal pores in 5/6, or 5/6/7. Described as 15-130 mm by 1-4mm

with 78-148 segments. Setae 20-100, always present on first segment. GMs numerous papillae in pre- and post-setal rows on 15,16-18 and 6,7-8,9; or only two large ones presetally on 17 in line with male porophores; or totally absent. Male pores (when present) on penes that are presumably retractable into copulatory pouches (hence *Metaphire*). Possibly a hodge-podge of degraded morphs for more than one species but unusual in all having setae on first segment, perhaps providing a means to identify the various components. From Hainan, NOT known from Japan but degraded morphs are possible to confuse with it].

'*Pheretima*' *oyuensis* Ohfuchi, 1937.

Pheretima oyuensis Ohfuchi, 1937a: 24. From Akita-ken. Types? [Overlooked by Reynolds & Cook (1976)].

Pheretima cyuensis (sic, laps. pro *oyuensis*): Sims & Easton, 1972: 225.

'*Pheretima*' *oyuensis* : Easton, 1981: 54.

Remarks: Sims & Easton (1972: 225) have as *incertae sedis* this degraded morph of an unknown species originally described as lacking spermathecae, genital markings, male pores, and prostates. The original description was based on two specimens that measured 50 and 55 mm and that had simple caeca and may thus be similar to *A. minimus* or possibly implicated in a species group not dissimilar to that involving *A. assacceus* (Chen, 1938).

From Akita, northern Honshu, Japan.

[End of *Amyntas illotus* species-group].

Amyntas octo (Ishizuka, 2000).

Pheretima octo Ishizuka, 2000b: 31. Japan.

Diagnosis: Size 70-100 mm; adiverticulate spermathecae in 5/6/7/8/9; male pores

superficial; genital markings combined with male pores; prostate glands present; intestinal caeca simple.

Remarks: Degraded morphs with defective spermathecae (no diverticula) perhaps similar to *A. stipatus* (cf. *Amyntas corticis*).

Amyntas stipatus (Ishizuka, 1999).

Pheretima stipata Ishizuka, 1999d: 236, Figs. 34-40; [misspelt "stripata" in Ishizuka (2001: 29)]. From Meiji-jingu (and Ueno Park), Tokyo.

Diagnosis: Spermathecae adiverticulate in 6/7/8/9; male pores superficial; genital markings stated to be absent but actually appear in figures just before and after male pores and almost combine just medially to each of them (possibly interpretable as 'bean-shaped'); prostate glands "often absent" (holotype?); intestinal caeca simple.

Remarks: Ancestral populations expected to have complete prostates and spermathecae. Similar to *A. phaselus* but spermathecal pores said to be in 6/7/8/9 rather than 5/6/7/8.

Amyntas tamaensis (Ishizuka, 1999).

Pheretima tamaensis Ishizuka, 1999d: 231, Figs. 8-17 [non *Pheretima tamiensis* Ude, 1924: 84 (= *Metapheretima myriochoeta* (Cognetti, 1911))]; miscited as "Ishizuka, 2000" in Ishizuka (2001: 69).

Diagnosis: Spermathecae adiverticulate in 6/7/8; male pores, if present superficial (at least in type); genital markings absent, or in some of 17/18/19 median to male pore line; prostate glands absent (always?); intestinal caeca simple. Size: 60-90 mm.

Remarks: Ancestral populations expected to have complete prostates and spermathecae. Possibly synonymous with *Amyntas micronarius*. Alternatively if male pores were

non-superficial, then it would belong in *Metaphire*.

***'Pheretima' palarva* Blakemore, 2003.**

Pheretima parvula Ishizuka *et al.*, 2000b: 186, figs. 17-24 (description, figure legends and scale bars are contradictory, confused, and intermixed). [Non *Perichata parvula* Goto & Hatai, 1898 (?= *Amyntas gracilis*); nec *Pheretima parvula* Ohfuchi, 1956 (= *Metaphire parvula*)]. [Note: this name mis-cited and misspelt as '*Pheretima parvula* Ishizuka, 2000' by Ishizuka (2001: 12, 69, 102) and "*P. parvora*" by Ishizuka (2001: 46)]. From The Imperial Palace, Tokyo, the types are stated to be in National Science Museum, Tokyo (Holotype NSMT -An 340, two paratypes An341).

Remarks: The replacement name, *P. palarva*, was provided for this junior (secondary and primary) homonym under ICZN (1999: Arts. 53.3, 57.2, 60.3, 67.8, 72.7) to provide a public and permanent record for replacement of a primary homonym. Ishizuka's (2001) subsequent misspellings or *lapsus calami* are not valid substitute names. Ishizuka *et al.* (2000b) originally applied this name to variously degraded morphs (lacking spermathecal diverticula, genital markings, prostate glands and, sometimes, the male pores) of some as yet undetermined taxonomic affinities. The spermathecal pores were described in 6/7/8 "and occasionally absent, variable in number", with the "duct occasionally absent; diverticulum absent". The caeca are simple and it is possible that these small specimens (46-62 mm) are in the same synonymy as would be *P. oyuenensis*, but Ishizuka *et al.* (2000b: 188) confuse the number of spermathecae present in the comparison with this taxon; or they may belong in the same synonymy as *Amyntas imperfectus* (Ishizuka, 1999). In comparison, *Metaphire parvula* (Ohfuchi, 1956) also has spermathecae in 6/7/8 and lacks genital markings but has male pores in copulatory pouches unlike those of *P. palarva* that appear to be superficial

(when present). Because the states of the male pores and spermathecal ducts in the holotype are not explicitly stated, this taxon is retained as *incertae sedis*. No nephridia were described on the nephridial ducts, a prerequisite for *Pheretima*, thus this dubious taxon is perhaps better described as "*Amyntas? palarvus*".

Of equal concern is Ishizuka's (2001: 46, Tab. 3-39) claim for detailed ecological/life-cycle study over six summer months for this 'species' that is however unsupported by the original description in Ishizuka *et al.* (2000: 186; 194 Tab. 2) where (66 or 68??) specimens were collected on only four different days in July and August, 1996/7.

Conclusions and Discussion

The present review is an attempt to define the status quo of the species and to establish some nomenclatural stability. It is also cautionary in that taxonomic progress can only be made by resolving, as far as possible, the inherited conflicts in species descriptions. Adding names to the list without such foundations is counterproductive, but unfortunately this seems an accepted practice in some reports, and not just those from Japan; where possible these names have been reallocated as appropriate herein.

The taxonomic problems of the *Metaphire hilgendorfi* species-complex imposed by its parthenogenetic polymorphism have been reviewed and a partial solution, involving separation of those taxa with affinities to *Amyntas tokioensis* into a new species-group, has been proposed. Full resolution perhaps involves molecular analysis of types, comparison with the variability of field material, and classification using Gates' codes for parthenogenetic morphs.

Understanding the earthworm diversity of any Oriental region requires

consideration of the species recorded from adjacent countries as distributions often overlap borders. The current review of Japanese earthworms provisionally lists only about 80 valid species belonging to 7 families, retaining most synonymies established by Easton (1981) and revising more recently erected taxa so that there are approximately an equal number of synonymous or uncertain names (i.e., ca. 80 species names or 50%). Of the putatively valid species, about 30 are known introductions and another 10-12 are possibly introduced species or have wider distributions, thus the probably number of wholly endemic taxa is approximately 38-40 species (ca. 50%). This diversity compares with approximately 41 species from Taiwan (with 18 native taxa); 105 from mainland China (82 native); 45 species from Korea (27 native, but other natives recently added); and 19 species from the historical region of Northeast China called Manchuria (5 native) [these totals from Tsai *et al.* (2000; 2001) who also give historical accounts and biogeographical notes for these regions]. Gates (1972) described about 174 mainly pheretimoid species from Myanmar (Burma) with much information of their relationships to other Oriental faunas. In contrast, the British Isles of similar size to Japan have only 48 taxa comprising species that are unlikely to be entirely endemic having colonized after the last ice age, and many of which are also recorded as common exotics elsewhere (Sims & Gerard, 1985; 1999). Approximately 160 species are known from North America that was also widely glaciated; ca. 350 species are reported from India; 193 species (170 native) from New Zealand that, like Japan, has recent volcanic activity; ca. 430 (with ca. 350 native) from Australian mainland; and 230 (with ca. 200 native) from Tasmania – all these species counts are from Blakemore (1999; 2000; 2002). These totals of the distribution and diversity of taxa within a particular region are sometimes merely indicative of the extent of the taxonomic effort there; yet, once the species

identifications are determined and the taxonomic tangles resolved, useful information can be extracted for the benefit of ecologists, environmental managers, and other interested researchers. Of particular interest is the influence of human migrations and commerce on the distribution of the cosmopolitan and peregrine species (see Blakemore, 2002), and the effect of these on the native faunas.

Continued revision of Oriental earthworms involving mining museum collections, directed field survey to resample missing types, objective analysis of molecular (DNA or RNA) sequences, and Gatesian codification for degraded morphs, would involve considerably greater allocation of funds and personnel resources than are presently available; however, modest studies along these lines have commenced and one anticipated product is an interactive computer guide to Japanese earthworms.

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Table 1. Summary characters of the *Pheretima* group of genera (after Easton, 1982).

Genus	Testes segments	Intestinal caeca origin	Male pores *	Nephridia on spermathecae*
<i>Amyntas</i>	10+11, 10 or 11	25,26-28	Superficial	No/Yes
<i>Begemius</i>	11 only	25,26	Superficial	No
<i>Metapheretima</i>	10+11, 10 or 11	Absent	Superficial or Pouched	Yes
<i>Metaphire</i>	10+11, 10 or 11	27	Pouched	No
<i>Pheretima</i>	10+11	27	Pouched	Yes
<i>Pithemera</i>	10+11, or 11	22-24	Superficial	No
<i>Polypheretima</i>	10+11 or 11	Absent	Superficial or pouched	No

*Specimens lacking male pores and/or spermathecae cannot easily be accommodated.

Crescentic marks around the male pores (which characterize *Begemius*, *Metapheretima* and occur in several species of some other genera) are not found in *Polypheretima*. In *Polypheretima* the spermathecae may also be multiple, i.e., polythecal as in some species of *Amyntas*, *Metapheretima*, and *Metaphire*, or aborted; when present, the diverticula are simple (cf. multilocular in *Archipheretima*).

Table 2. Page references for taxa mentioned in Ishizuka's 2001 summary.

Species name (all "Pheretima")*	Claimed Author*	Page	Notes
<i>conjugata</i>	Ishizuka, 1999	59	(= <i>Amyntas koreanus</i> (Kobayashi, 1934)).
<i>schmardae</i>	(Horst, 1883)	59	
<i>aokii</i>	Ishizuka, 1999	60	(= <i>Metaphire soulensis</i> (Kobayashi, 1938)).
<i>bimaculata</i>	Ishizuka, 1999	60	Figures completely confused.
<i>hilgendorfi</i>	(Michaelsen, 1892)	61	
<i>irregularis</i>	(Goto & Hatai)	61	Probably <i>A. tokioensis</i> .
<i>okutamaensis</i>	Ishizuka, 1999	62	
<i>purpurata</i>	Ishizuka, 1999	62	
<i>silvatica</i>	Ishizuka, 1999	63	
<i>surcata</i>	Ishizuka, 1999	63	Segments totally miscounted and confused.
<i>verticosa</i>	Ishizuka, 1999	64	
<i>vittata</i>	(Goto & Hatai, 1899)	64	
<i>bigibbrosa</i>	Ishizuka, 1999	65	
<i>communissima</i>	(Goto & Hatai, 1898)	66	
<i>frolea</i> <i>florea</i>	Ishizuka, 1999	66	
<i>agrestis</i>	(Goto & Hatai, 1899)	67	
<i>striata</i>	Ishizuka, 1999	67	
<i>imperfecta</i>	Ishizuka, 1999	68	

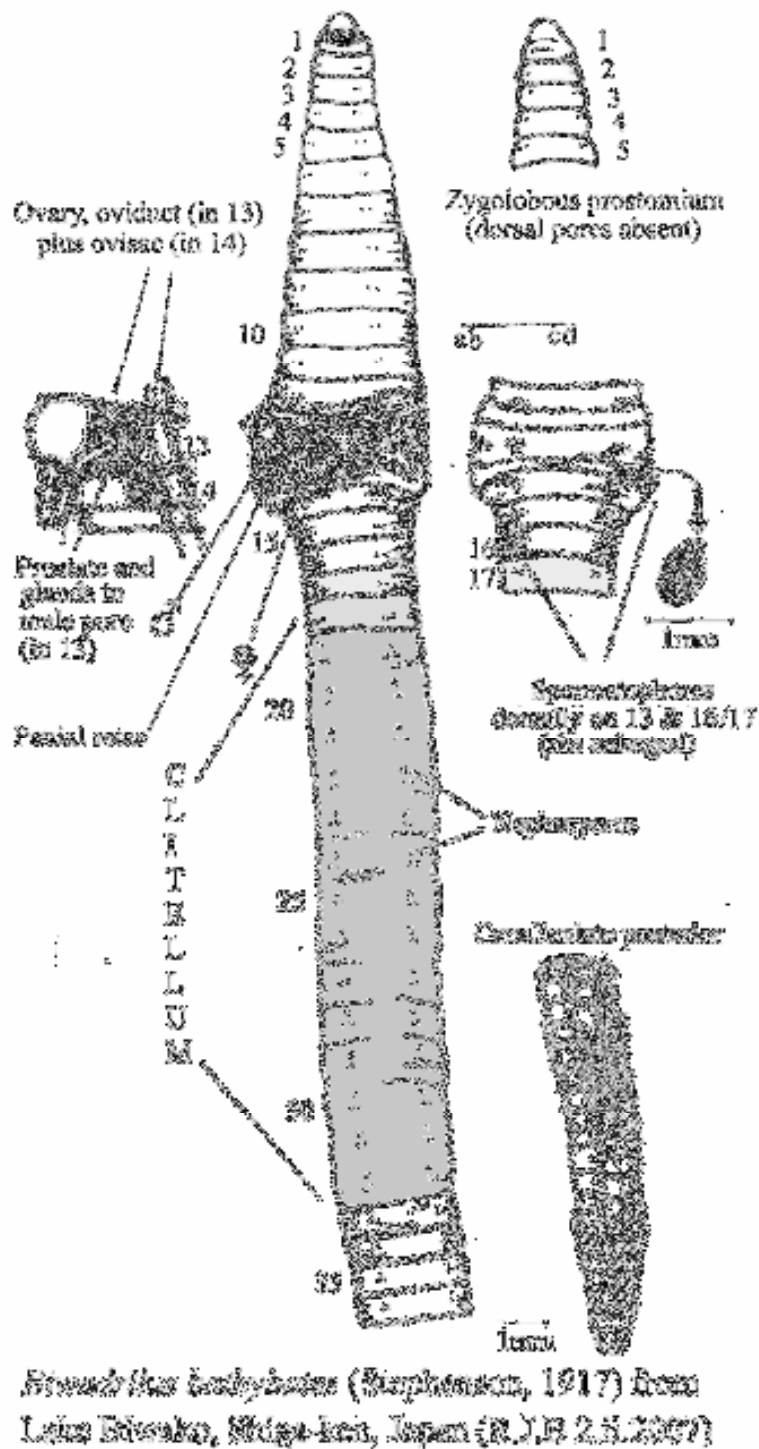
<i>hiberna</i>	Ishizuka, 1999	68	
<i>parvola</i>	Ishizuka, 2000	69	
<i>parvula</i>	Ishizuka <i>et al.</i> , 2000		
<i>tamaensis</i>	Ishizuka, 2000	69	
<i>hupeiensis</i>	(Michaelsen, 1895)	70	
<i>hypogaea</i>	Ishizuka, 1999	70	
<i>elliptica</i>	Ishizuka, 1999	71	
<i>phasela</i>	Hatai, 1930	71	
<i>stipata</i>	Ishizuka, 1999	72	
<i>flavida</i>	Ishizuka, 2000	73	
<i>rufidula</i>	Ishizuka, 2000	73	
<i>semilunaris</i>	Ishizuka, 2000	74	
<i>silvestris</i>	Ishizuka, 2000	74	
<i>subrotunda</i>	Ishizuka, 2000	75	
<i>carnosa</i>	(Goto & Hatai, 1899)	75	
<i>disticha</i>	Ishizuka, 2000	76	
<i>edoensis</i>	Ishizuka, 2000 Ishizuka, 1999	76	Spermathecae miscounted.
<i>fulva</i>	Ishizuka, 2000	77	
<i>heteropoda</i>	(Goto & Hatai, 1898)	77	
<i>hinoharaensis</i>	Ishizuka, 2000	78	
<i>invisa</i>	Ishizuka, 2000	78	Non Cognetti, 1913. Fig. 1 segments miscounted? Figure legends incorrect.
<i>lactea</i>	Ishizuka, 2000	79	
<i>micronaria</i>	(Goto & Hatai, 1898)	79	

<i>mitakaensis</i>	Ishizuka, 2000	80	
<i>monticola</i>	Ishizuka, 2000	80	
<i>mutabilis</i>	Ishizuka, 2000	81	
<i>nubicola</i>	Ishizuka, 2000	81	
<i>octo</i>	Ishizuka, 2000	82	
<i>pingi</i>	Chen, 1936 Stephenson, 1925	82	
<i>subalpina</i>	Ishizuka, 2000	83	
<i>subterranea</i>	Ishizuka, 2000	83	
<i>umbrosa</i>	Ishizuka, 2000	84	
<i>conformis</i>	Ishizuka, 2000	84	
<i>quintana</i>	Ishizuka, 2000	85	
<i>masatakae</i>	(Beddard, 1892)	86	
<i>maculosa</i>	Ishizuka, 1999 Hatai, 1930	86	
<i>autamunalis</i> <i>autumnalis</i>	Ishizuka, 1999	87	
<i>alpestris</i>	Ishizuka, 1999	87	
<i>argentea</i>	Ishizuka, 2000	88	
<i>confusa</i>	Ishizuka, 1999	88	
<i>divergens</i>	(Michaelsen, 1892)	89	
<i>dura</i>	Ishizuka, 1999	89	
<i>iizukai</i>	(Goto & Hatai, 1899)	90	
<i>negera</i> <i>nigella</i>	Ishizuka, 2000	90	
<i>nipparaensis</i> <i>nipparensis</i>	Ishizuka, 1999	91	
<i>setosa</i>	Ishizuka, 2000	91	Non Cognetti, 1908
<i>montivaga</i> /	Ishizuka, 1999	92	Illegitimate names.

<i>montana</i>				
<i>atrorubens</i>	Ishizuka, 1999	92		
<i>imajimai</i>	Ishizuka, 1999	93		
<i>turgida</i>	Ishizuka, 1999	93		
<i>megascolidioides</i>	(Goto & Hatai, 1899)	94	Figure 7 upsidedown.	

*Many of these are incorrect citations. Total number of taxa claimed - 68; total number claimed authorship by Ishizuka - 52 (or 77%).

[End of Japanese Earthworms text] .



[Fig. 1](#) *Biwadrilus bathybates* (original figure RJB).

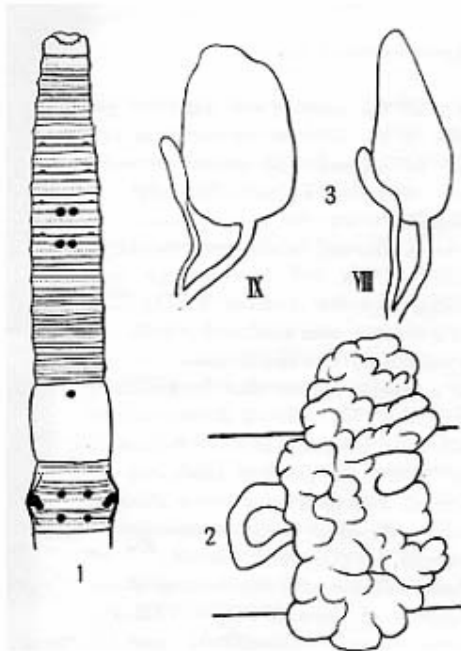
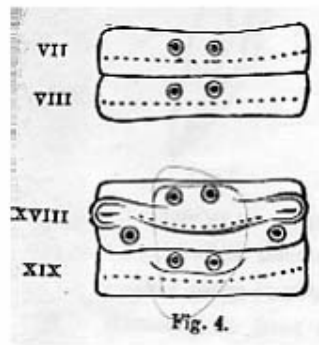
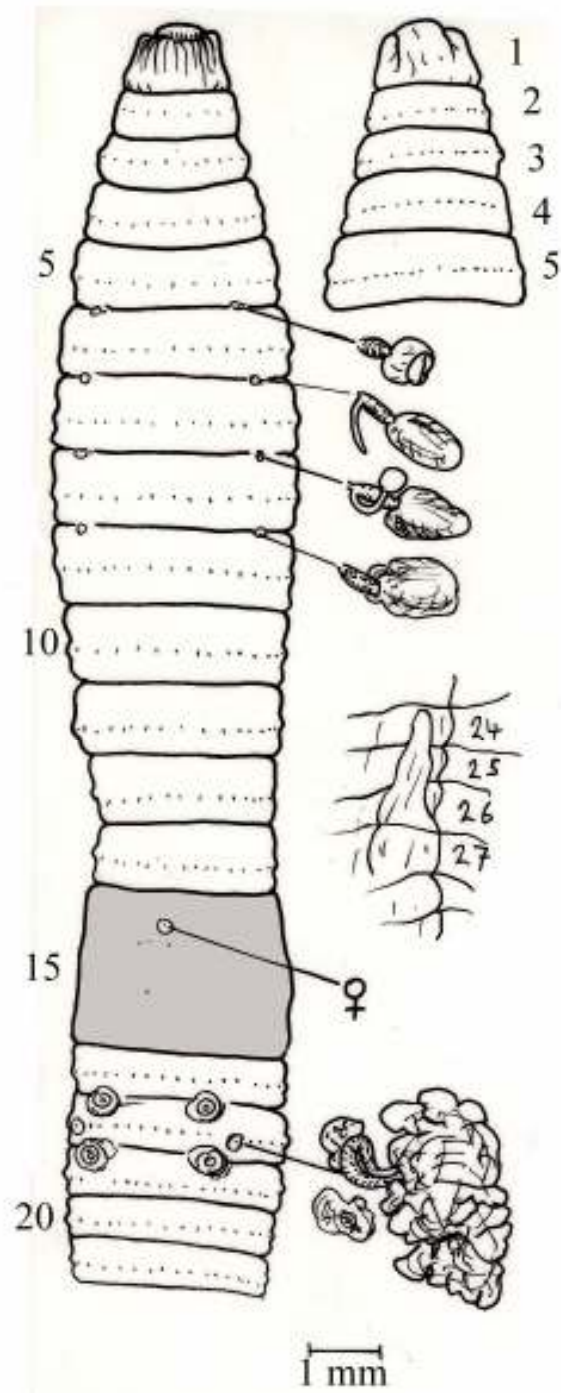
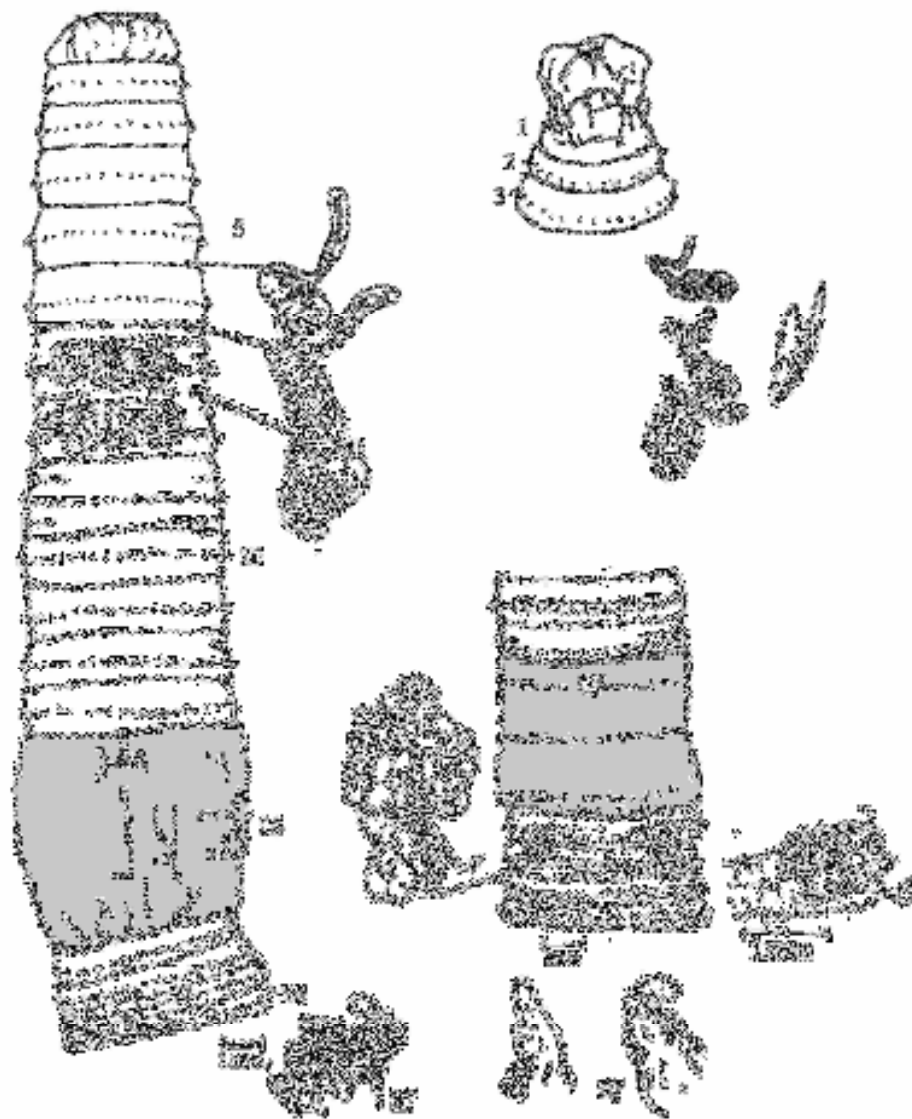


Fig. 2 *Amynthus carnosus* (Goto & Hatai, 1899):
top Goto & Hatai original Fig. 4; bottom Ph. *kyamikia* Kobayashi, 1934

Fig. 2



[Fig. 3](#) *Amynthus micronarius* (Goto & Hatai, 1898). Sketch of a Watarase specimen.



Amynthus agrestis (Goto & Hatai, 1899)

1 - 2nd antennal segment; 3 - 3rd antennal segment

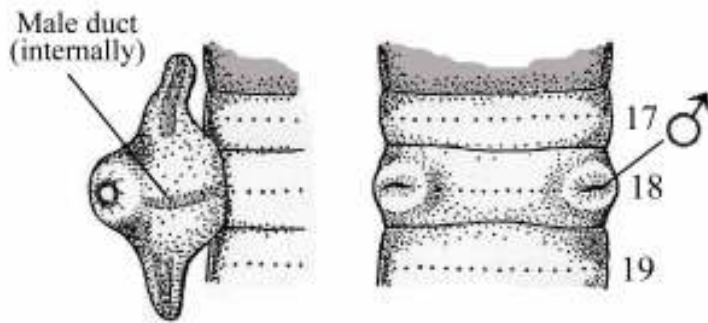
4 - 4th antennal segment; 5 - 5th antennal segment

6 - 6th antennal segment; 7 - 7th antennal segment

8 - 8th antennal segment; 9 - 9th antennal segment; 10 - 10th antennal segment; 11 - 11th antennal segment

Fig. 3.1 *Amynthus agrestis* (Goto & Hatai, 1899). Sketches of two specimens from Ami, Ibaraki-ken (collected by author, August, 2006), plus original text-figure of a spermatheca.

1, 2).

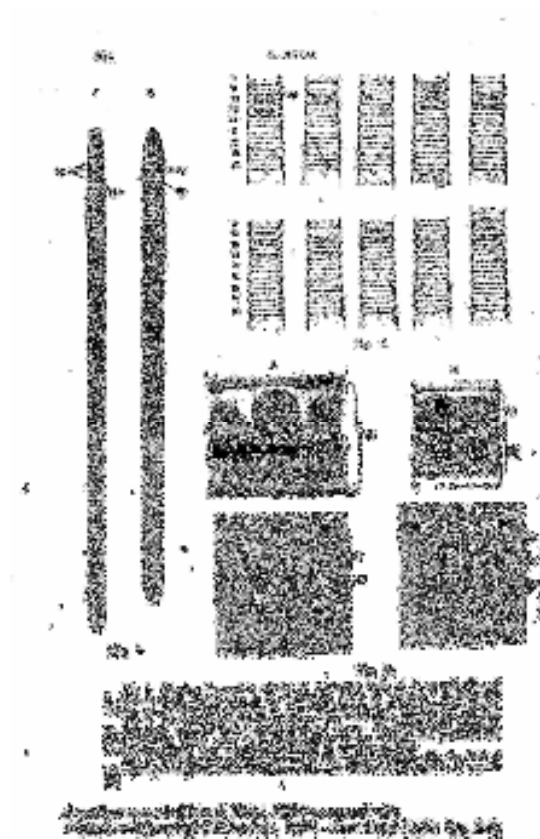


Metaphire schmardae with everted copulatory pouch (lhs) and regular male field (after Hatai & Ohfuchi, 1936).

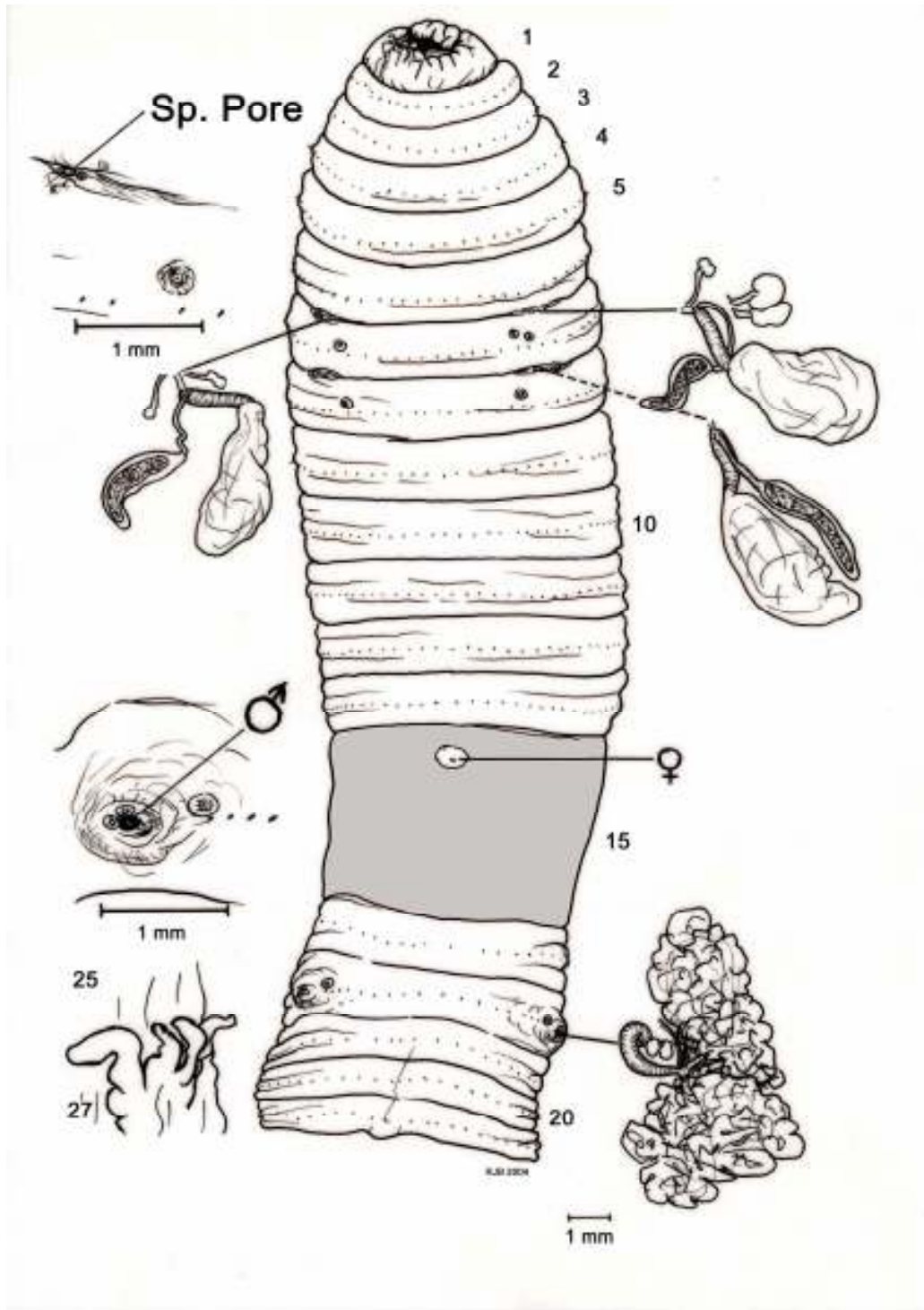


Metaphire schmardae - intestinal caecum (maniculate or multiple) - after Hatai & Ohfuchi (1936) (fig 57)

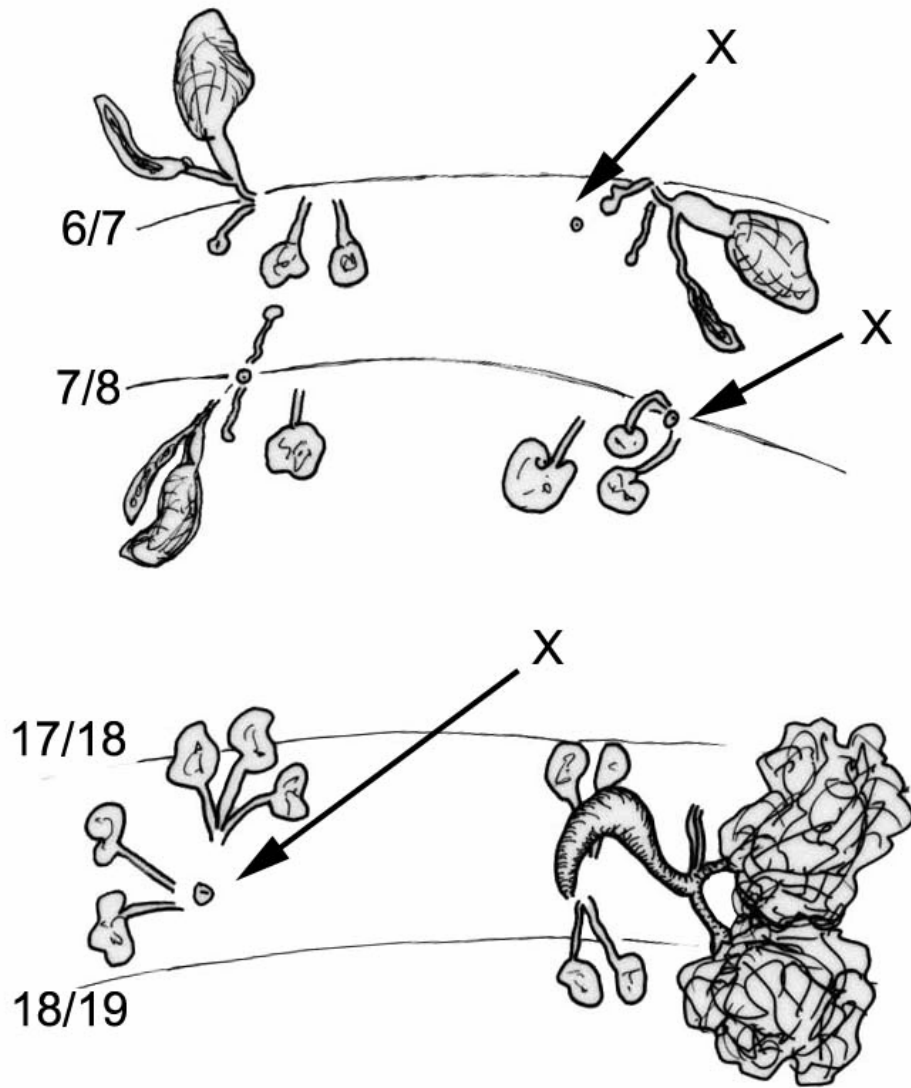
[Fig 4.1](#) [Fig 4.2](#) *M. schmardae*, eversible male pores and intromittent organs and manicate (or multiple) intestinal caeca (after Hatai & Ohfuchi, 1936, for their *P. kikuchii* synonym).



[Fig.5](#) *Amyntas agrestis* compared with *M. hilgendorfi* from Hatai (1930; figs. 1-3).



[Fig. 5.1](#) *Amynthus tokioensis* (Beddard, 1892). Sketch of previously dissected type specimen.

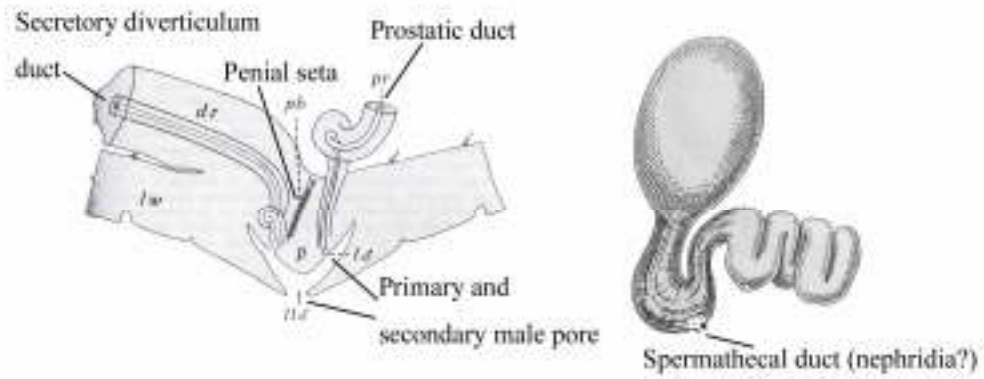


[Fig. 5.2](#) *Amynthus tokioensis* (Beddard, 1892). Sketch of internal arrangement of spermathecal and male field of type (not to scale). X - site of previously removed genital gland, spermatheca, and prostate gland. (Spermatheca in 8lhs was loose in the jar).



Fig. 4.3 *Amyntas tokioensis*.

Top from Goto & Hatai (1889); Bottom, spermatheca from Ishizuka (2001: 61) "*P. irregularis* (Goto & Hatai, 1899)," but it is actually *A. tokioensis*.



P. koellikeri Michaelsen, 1928: Section of male pore and a spermatheca.

[Fig 6](#) *P. koellikeri* figure of male pore and a spermatheca from Michaelsen (1928: figs.

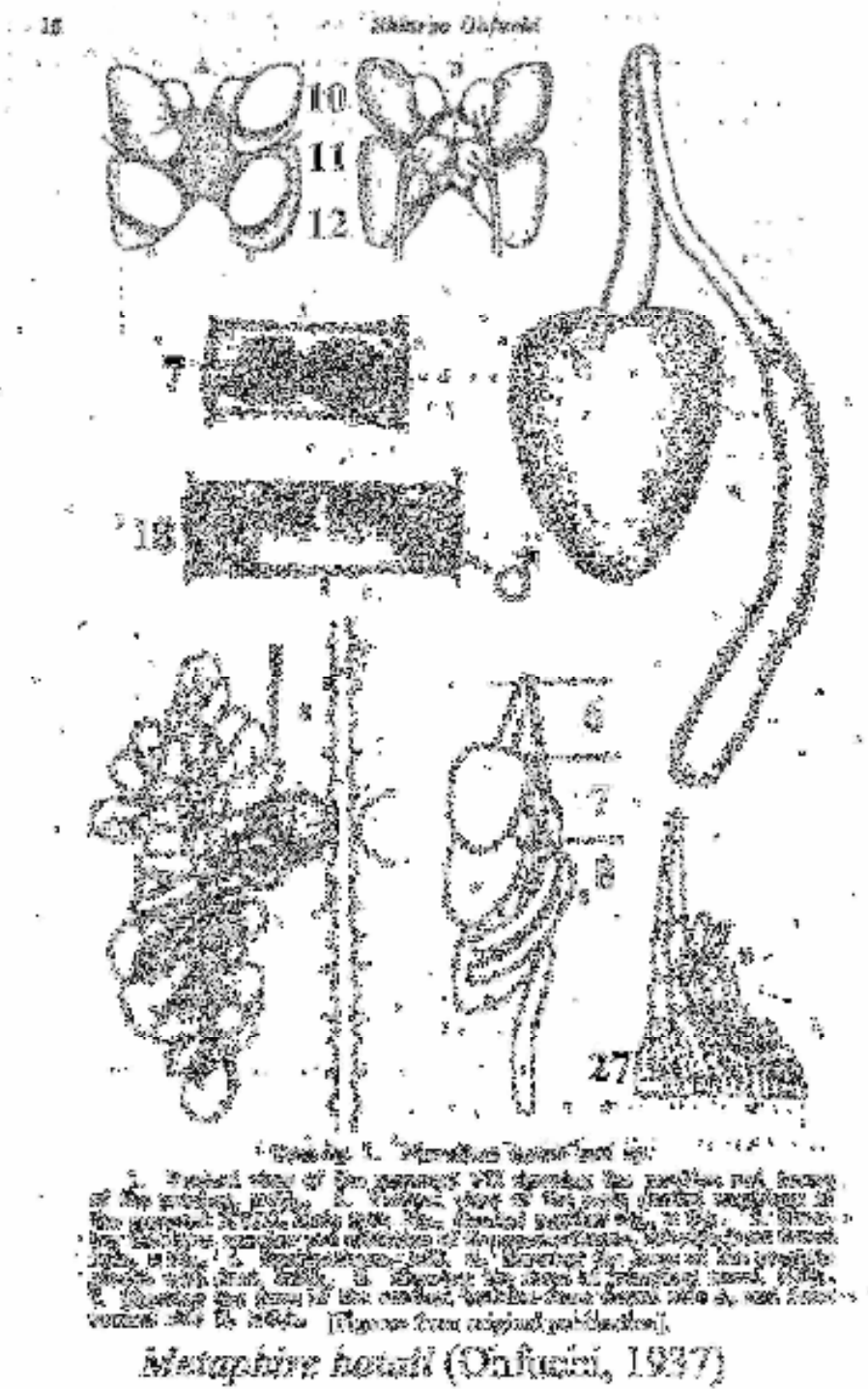


Fig. 7 *Metaphire hataii* (Ohfuchi, 1937). Based on original figures.