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Preface [to Identification Keys to Strongylid Nematode Parasites of Equids]

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Preface

In the early 1970s the Agricultural Research Service was involved in evaluating anthelmintics for horses. I was asked to prepare illustrated identification keys for the helminths. Because there were so few systematists in Veterinary Helminthology then (and, even fewer now), I became an instant expert when my keys were published in 1975. All of our knowledge of the 64 species of strongylids of horses is recorded under the species names. If identifications are incorrect, or if taxonomists in different parts of the world use different names for the same species, the information attributed may be confusing or even lost. An important value of my 1975 paper on helminths of horses was that the taxonomy that I employed was endorsed by an American Association of Veterinary Parasitologists Committee, thus encouraging wider acceptance for the names used for these economically important nematodes.

A period of relatively stable taxonomy followed the publication of my 1975 identification keys, at least in most English literature. However, in the former Soviet Union a considerably different taxonomy was followed because of disagreement over the validity of the genus *Cyathostomum* and its type species *C. tetracanthum*. Workers in the Skrjabin school used the genus *Trichonema* instead of *Cyathostomum* for a large number of species. (See the landmark paper of Popova published in 1955 and translated to English in 1964.) When Hartwich published a revision of the largest subfamily of strongylids of horses, the Cyathostominae, in 1986, in which he changed the names of several common species, including *Cyathostomum tetracanthum*, it was clear to me that the stability of the taxonomy of the group was threatened severely, and that it was my responsibility to do something about it.

Research activity on nematodes of horses was high in the mid 1990s for several reasons including: (1) larval

cyathostominosis (previously cyathostomosis or cyathostomiasis), a syndrome in which large numbers of larvae emerge from the walls of the large intestine and cecum and cause severe colitis that may result in death, was recognized increasingly; (2) resistance to anthelmintics within the Cyathostominae had been reported widely; (3) biological control prospects, using nematode-trapping fungi, appeared to be promising; and (4) DNA markers were being developed for diagnostic use and for phylogenetics.

With research activity high, and the stability of the taxonomy of the group threatened, an international workshop on the systematics of strongylid nematodes of horses was convened at the 1997 Sun City meeting of the World Association for the Advancement of Veterinary Parasitology (WAAVP). In the interest of taxonomic stability, the Sun City workshop voted (with the concurrence, (personal communication) of Dr. Gerhard Hartwich) to ask the International Commission on Zoological Nomenclature to validate the names in use prior to Hartwich's 1986 proposal. The ICZN granted our request in 2001 (Opinion 1972). The Sun City workshop made additional recommendations, including: (1) publish a checklist of species and genera of the Cyathostominae and (2) publish updated identification keys for strongylid nematodes of horses. The proposed work was funded by the Agricultural Research Service, U.S. Department of Agriculture (Lichtenfels) and by the United States Civilian Research and Development Foundation (Lichtenfels and Kharchenko). The checklist was published in *Veterinary Parasitology* in 1998 and the identification keys are presented in the following paper.

The 1997 WAAVP Sun City workshop was followed by others in 1999 at Copenhagen and 2001 at Stresa. These workshops stimulated and guided considerable contributions to the taxonomy of strongylid nematodes

of horses including descriptions of 5 new species and redescriptions of numerous poorly described species. Contributions of the workshops were described in *Veterinary Parasitology* in 2002. During the late 1990s and early 2000s work, on biological control, DNA probes, treatment and control, wildlife management, and molecular phylogeny provided freshly collected specimens for the work on systematics and the identifications provided by the systematists made all of this work possible. The international cooperation achieved through the 3 WAAVP workshops resulted in extraordinary advancements in these areas, and for the first time, worldwide agreement, on the taxonomy of the strongylid nematode parasites of horses, zebras and asses. I thank especially my coauthor of the keys presented in the following paper, Vitaliy A. Kharchenko, National Academy of Sciences of Ukraine, Kiev; also, R. C. Krecek, Ross University School of Veterinary Medicine, St. Kitts, West Indies; and L. M. Gibbons, The Royal Veterinary College, University of London, for leadership roles and research contributions that significantly advanced the objectives of the workshops. In addition to the WAAVP, the workshops were supported by Hoechst-Roussel Vet; Merck & Company, Merial Division; Pfizer Corporation, Central Research Division; and The Brayton H. Ransom Memorial Trust Fund. All of the above and numerous other cooperators at the 3 WAAVP workshops, previous workers who collected and/or described strongylids from horses, and museum curators and others who provided type and other specimens made it possible for us to prepare updated descriptions and illustrations, and keys to the genera and species of adult strongylid nematodes of equids. It consists of illustrated keys to 19 genera and 64 species. Generally both male and female specimens can be identified to species by characteristics of the mouth and buccal capsule, so photomicrographs are provided to illustrate these characters. Line drawings of spicules, gubernaculum and copulatory bursa of males, and tail and ovejectors of females are also provided.

The major challenges to identifying the 64 species of strongylid nematodes of horses are the species complexity of the populations, and our inability to identify life stages of the nematodes that are available outside the host such as eggs in feces or free-living larvae on pasture. Only adult nematodes can be identified to species microscopically and specimens in condition for identification are usually obtained from sacrificed hosts. The objective of the following identification keys is to facilitate the identification of adult nematodes. The development of DNA probes,

which will make it possible to identify eggs and larvae, is dependant on accurate identification of adult specimens. Because characteristics of the mouth and buccal capsule are generally sufficient to identify both male and female adult specimens to species, anterior ends of adult specimens can be removed and identified when it is necessary to identify individual specimens from which DNA will be extracted. It is important to note here that we used phenol-alcohol (80% melted phenol crystals in 20% absolute ethanol) to clear specimens for study. Other experts on these nematodes who previously used other clearing agents have been amazed to see the improved clarity of specimens cleared in this solution.

In addition to my 1975 keys to these nematodes, the current work relied heavily on major works by others, especially Hartwich's 1986 paper and Dvojnos and Kharchenko's 1994 paper. Detailed comparisons of differences among the previous systematic treatments of the strongylid nematodes of horses are provided in the History section of the following paper. Despite the rejected name changes proposed by Hartwich, his work provided significant new characters and 2 new genera that greatly improved the systematics of the group. The classification of the strongylids of horses provided by Dvojnos and Kharchenko in 1994 included a generic classification of the Cyathostominea that differed remarkably little from the systems of Lichtenfels and of Hartwich. They abandoned completely the genus *Trichonema* used in earlier systems of workers in the former Soviet Union. A recent treatment of the systematics of these nematodes in China by Zhang and K'ung in 2002 followed the generic classification of the Cyathostominea recommended by the Sun City workshop. Because of research needs and outstanding international cooperation, a consensus taxonomy and classification for the strongylid nematodes of horses has become a reality in the following paper by Lichtenfels, Kharchenko and Dvojnos.

Although the following paper provides a research tool that will be useful for decades, unanswered questions remain and some research opportunities can be identified. A morphological phylogeny is needed to test the classification of the Strongylidae. A short discussion of phylogeny is presented in the following paper, but work on a morphological phylogeny is incomplete. Species specific diagnostic DNA probes are needed to test control methods and agents without sacrificing the hosts. Such diagnostic probes cannot be developed without the use of the identification keys in the following paper.

I retired during the preparation of this work. Now as I fade away, I am content that, with the aid of colleagues, I am leaving the systematics of strongylid nematode parasites of horses in better shape than I found it several decades ago. After my 1975 keys were published, the late and great veterinary parasitologist, Arlie C. Todd, sent me a thank you card signed by all of his graduate students with a note that he could now play golf without feeling guilty while his students identified nematodes from horses. With the publication of the new keys, I can now play golf without feeling guilty!

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