New host and the extend of the host range of warble fly *Hypoderma diana* (Diptera, Hypodermatidae)

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Abstract: Warble fly *Hypoderma diana* is known to be a parasite not only of roe deer and other species of Cervidae but also of non-specific hosts from among other orders of ungulates. First-instar larvae of *Hypoderma diana*, a specific parasite of Cervidae, have been found in a new non-specific host, i.e. the wild boar (*Sus scrofa*). This finding is further evidence of the exceptional adaptability of this species of subcutaneous warble fly of the family Hypodermatidae. It corroborates the validity of the proposition that the host range of a host-specific parasite can only be extended when both the original and the new host species are simultaneously present in large numbers.

Key words: Diptera, Hypodermatidae, *Hypoderma diana*, wild boar, non-specific host, Czech Republic

Introduction

Warble flies of the suprafamily Oestroidea are a distinct group of higher flies (Cyclorrhapha) whose larvae are endoparasites of mammals. Warble fly ancestors were free-living flies (Hennig 1958, Rodendorf 1964, Obenberger 1964, Martynov 1964, etc.), from which they separated when they adopted the parasitic way of life in some mammalian orders (Grunin 1962, Darlington 1963, etc.). The adoption of the parasitic mode of existence triggered considerable physiological and morphological changes in warble flies reflecting the fact that as parasites they spent a larger part of their ontogenetic development in the secondary environment of the host's body (Dogel 1947, Povolný 1962, etc.).

Warble fly *Hypoderma diana* differs from other warble flies species because it has several hosts. In addition to the European roe deer (*Capreolus capreolus*), which is its main host, *Hypoderma diana* infests also other cervids, e.g. the red deer (*Cervus elaphus*), fallow deer (*Dama dama*), Dybowski sika deer (*Cervus nippon dybowskyi*), Eurasian elk (*Alces alces*), rarely also the chamois (*Rupicapra rupicapra*) and the mouflon (*Ovis musimon*). Second-instar larvae have also been found in the reindeer (*Rangifer tarandus*) (Grunin 1962, Minář 1980, etc.).

Methods

A subcutaneous tissue sample taken from the back of a wild boar (*Sus scrofa*) killed in January 2013 in the Litoměřice district was sent to the State Veterinary Institute Prague where two larvae of the subcutaneous warble fly *Hypoderma diana* 12 x 2 mm in size were found.

Results

The larvae featured characteristic mouth hooks on the head segment (pseudocephalus), and multiple breathing pores on the 8th segment. No pathological changes at the site of infestation were found. This is the first time that larvae of the subcutaneous warble fly *Hypoderma diana* have been found in a wild boar.

Discussion

Warble flies are specific parasites infesting primarily one host species, or, sporadically, several of closely related species. The abundance of specific parasites in the host population (in the case of warble flies the number of maturing larvae per host) is therefore limited by an internal regulatory system that evolved in the course of phylogenesis from non-specific parasitism, and is manifested by the negative binomial distribution of the third instar larvae (Breev 1972, 1973, Breev & Minář 1981, 1986, 1993, 2000).

Because of those factors, a switch to a new host is very rare in specific parasites. The switch does not occur when the original host is becoming extinct as some authors believed (Rubcov 1940, Papavero 1977) but only at the time when both the original host and the new host were abundant at the same time. In the case of warble flies, a permanent switch to a new host is known only in the subcutaneous warble fly *Oestromyia leporina*, which is a parasite of the pikas of the genus *Ochotona* in Asia. In Europe and Western Siberia, however, it parasitizes voles of the genus *Microtus*. In the pleistocene, pikas also lived in Europe, and four Asian species of the genus *Oestromyia* parasitized exclusively on pikas (Grunin 1950, 1957.)

With the exception of the warble fly *Hypoderma diana*, larvae of other warble flies are only rarely found on non-specific hosts. Individual larvae of the northern cattle grub *Hypoderma bovis* have been found on horses (Baker & Monlux 1939, Potěmkin & Vedernikov 1944, Scharff 1962), goats (Minář & Povolný 1971), sheep (only 1st instar larvae – Grunin 1962) and also man (Grunin 1962, Doby & Beaucournu 1966).

In the last century, larvae of the warble fly *Hypoderma diana* were collected from other non-specific hosts. Mouflons were brought to Central Europe from their original territory in Corsica a hundred years ago (Mottl 1960), and some time later were introduced to Eastern Europe where individual, usually dead, first-instar larvae of the warble fly *Hypoderma diana* were found on mouflons in the first half of the 20th century (Grunin 1962). In the last decades of the 20th century, cases of severe mouflon infestations with up to several dozen first- and second-instar larvae of *Hypoderma diana* per animal were reported in the former Czechoslovakia. In all these cases, both hosts were abundant at the same time (Minář 1982, 1983, 1984).

The first- and second-instar larvae of the warble fly *Hypoderma diana* were found on other species of the order Artiodactyla, namely on four species of African antelopes kept in the Dvůr Králové zoo (Váhala et al. 1991). The finding of the warble fly *Hypoderma diana* larvae on horses, members of another mammalian order, Perissodactyla, in the 1980s is noteworthy. At that time, dead third-instar larvae (Minář 1987, Vysloužil 1989) and live second-instar larvae (Minář 1995) of the species *Hypoderma diana* were found on several young horses. In the following years, larger numbers of second-instar larvae of the warble fly *Hypoderma diana* were found on several dozen horses of different ages in a number of other locations in the Czech Republic (Minář et al. 2001, Jahn et al., 2002).

All these cases and the case of a wild boar infestation with *Hypoderma diana* larvae reported in this paper testify to the extraordinary ability of this species of a specific parasite to switch to a new host. This is also indicated by the broad range of host species from the family Cervidae. Also noteworthy are the findings in ungulates of other families of the order Artiodactyla – the cavicorns and the Suidae, and also in another order, i.e. the Perissodactyla.

Roe deer have been very abundant in recent years in the Czech Republic (Kotrlá et al. 1984, Minář 1982, 1984, 1997, Minář et al. 1986, Lamka et al. 1997, Čurlík 1997, etc). Wild boars, particularly in recent years, are also abundant, even overpopulated. The above findings corroborate the assumption that a switch to a new host, or an attempt at such a switch, by a specific parasite will be made only in a situation when both host species are simultaneously present in large numbers.

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