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BRIEF OVERVIEW OF BOVINE HYPODERMOSIS IN KAZAKHSTAN AND OTHER CENTRAL ASIAN REGIONS - WITH A RECOMMENDATION TO CONTROL THIS PARASITOSIS BY GOVERNMENT SUPPORT

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Abstract

Hypodermosis is known to be a parasitosis of cattle having a negative economic impact. Nevertheless, it is still (or again) highly prevalent in Kazakhstan and other Central Asian regions. This is mainly attributable to the restructuring and privatization of animal husbandry after the dissolution of the former Soviet Union that was associated with economic and social problems, some of them still persist in agriculture today.

In view of its negative economic impact, bovine hypodermosis should be controlled by appropriate measures, also by government support and regulations, in order to improve the animal health and the profitability of cattle farming and thus to increase the income of small-holding farmers in particular.

The aim of the present paper is to provide an understanding and background for this recommendation. After a description of related English terms and the life cycle of *Hypoderma* species, a brief review is given on the occurrence of bovine hypodermosis in Kazakhstan and other Central Asian regions and its economic impact as well as on current options to control and eradicate this parasitosis.

Keywords: *Hypoderma*, hypodermosis, cattle, prevalence, economic impact, control, Kazakhstan, Central Asia.

Introduction

Bovine hypodermosis had been substantially diminished or even eradicated by appropriate control measures in several west European countries for many years [1,2]. In contrast, this parasitosis is still prevalent in Kazakhstan and other Central Asian regions (see below). The explanation for this can be found in the history of animal husbandry: bovine hypodermosis had been controlled and reduced, but not eradicated, in the former Soviet Union including its Central Asian regions during the last decades of the 20th century [3]. However, after the dissolution of the Soviet Union and the independence of Kazakhstan and other former Soviet republics the agricultural system was restructured and collective farms were privatized in the nineties, resulting in large economic and social problems. Since then, there has been no systematic control of hypodermosis [4].

Currently, the national population of cattle comprises approximately 7,150,000 heads, including 3,000,000 dairy cows, in Kazakhstan. The vast majority of dairy cows are kept by private households for subsistence (61.6%) and

on small farms (31.7%); just 6.7% of the cows are kept on large agricultural enterprises according to the official veterinary census [5]. Small-scale livestock holders are usually poor, e.g., in eastern Kazakhstan [6], and most of them have little, if any, knowledge of useful preventive measures.

Therefore, in view of its negative economic impact (see below), this parasitosis should be controlled with appropriate measures, also by government support and regulations, if possible, in order to improve the animal health and the profitability of cattle farming and thus to increase the income of small farmers in particular.

The aim of the present paper is to provide an understanding and background for this recommendation.

After a description of related English terms and the life cycle of *Hypoderma* species (spp.), a brief review is given on the occurrence of hypodermosis in Kazakhstan and other Central Asian regions and its economic impact as well as on current options to control and eradicate this parasitosis.

Hypoderma species and terminology

Hypodermosis is an arthropod infection of domestic and wild ruminants. In cattle and other bovine species (yak, buffalo, and bison) it is caused by larval stages of three *Hypoderma* spp.:

- *H. bovis* (Linnaeus, 1758)
- *H. lineatum* (De Villers, 1789)
- *H. sinense* (Pleske, 1926), re-described as a valid species in western China [6].

Although these parasites are relatively host-specific and adapted to bovine hosts, few cases had been also reported from

sheep and goats [7], horses [8,9] as well as humans [10].

Hypoderma spp. belong to the family Oestridae (“**bot flies**”). The common English name of bovine *Hypoderma* spp. is “**warble flies**” or “**cattle grubs**”. Their adult flies are also known as “**gad flies**”, referring to the escape response of cattle (termed gadding) attacked by these flies, or “**heel flies**”, referring to the defensive behaviour of cattle in kicking up the hind legs against attacking flies (see Fig. 1).



Figure 1 – Historical Dutch postcard by the ‘Cattle Grub Control Committee’ promoting the control of bovine hypodermosis in the Netherlands, published in the early 1950s. The drawing shows the characteristic defensive behavior of a cow attacked by *Hypoderma* flies on pasture: escape response (termed gadding) and kicking up the hind legs resulting in the name “gad fly” or “heel fly”, respectively (©photo: C. Bauer).



Figure 2 – Second- and third-stage larvae of *Hypoderma bovis* under the skin of a cattle. Inset showing two third-stage larvae; scale bar: 3 cm (©photos: Institute of Parasitology Giessen).

Life cycle of bovine *Hypoderma* spp.

Hypoderma spp. have an annual life cycle: Their adult flies have reduced mouthparts and cannot feed. They deposit eggs on the hair of hosts during grazing in summer. First-stage larvae hatch from the eggs within a few days, burrow through the host skin and migrate to the spinal canal (*H. bovis*) or esophagus tissue (*H. lineatum*, *H. sinense*) for overwintering. In following spring, the larvae reach the subcutaneous tissue of the back and

develop into second and third larval stages (Fig. 2), which form characteristic subcutaneous bumps ('warbles') (Fig. 3).

This larval parasitism is termed (sub)cutaneous or furuncular myiasis (from ancient Greek: "μύια" = fly). Finally, third-stage larvae emerge from the skin nodules after 1–2 months (Fig. 4) and drop to the ground for pupation [12,13].

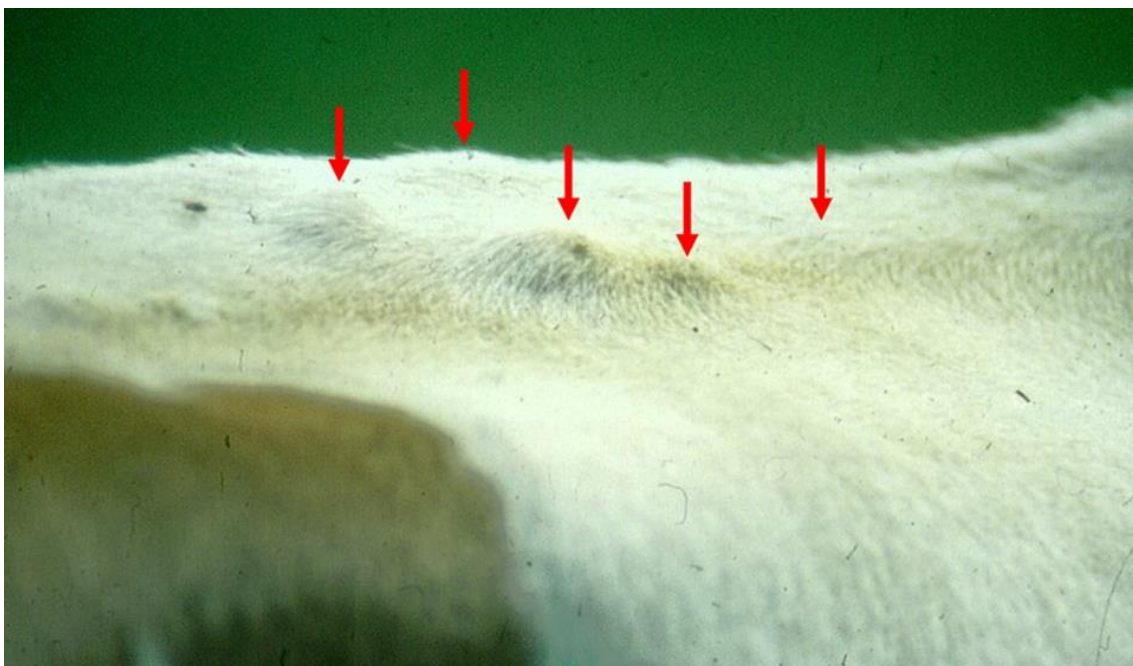


Figure 3 – Back of a cow showing several warbles (©photo: C. Bauer).



Figure 4 – A third-stage *Hypoderma* sp. larva emerging from the skin nodule in spring (©photo: C. Bauer).

Clinical and economic impact of bovine hypodermosis

Warbles cause pain and suffering of affected cattle that may result, depending on the larval counts, in

- a decrease of milk yield,
- lack of bodyweight gain and depreciated carcasses,
- as well as in considerable losses of the hide quality (Fig. 5) for the leather industry [14,15].

The total annual losses by hypodermosis in Russia were estimated at 6.5 billion

rubles (approximately 220 million US dollars) at the beginning of the 21st century [3]. The losses on damaged hides in northern China were estimated at 15 million US dollars a year [16].

Last but not least, because the internationally recognized animal welfare standards demand, inter alia, “freedom from pain, injury and disease” [17,18], hypodermosis causing painful warbles is also a problem of animal welfare.

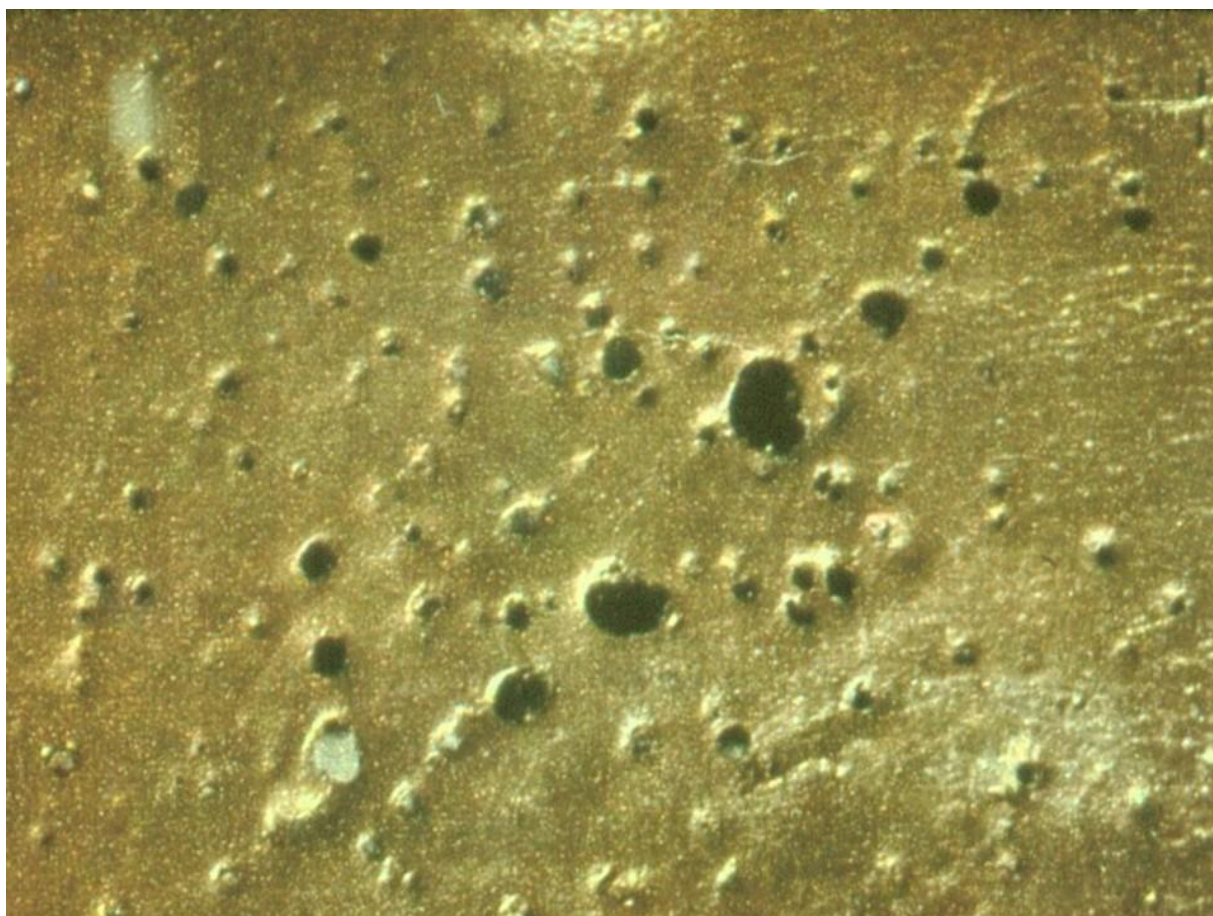


Figure 5 – Cattle hide damaged by *Hypoderma* sp. larvae (©photo: Institute of Parasitology Giessen).

Species distribution and prevalence of bovine hypodermosis

Bovine hypodermosis occurs in the northern hemisphere only [12,19]. *H. bovis* and *H. lineatum* are the species found in Kazakhstan [20,21,22,23], Kyrgyzstan [24], Uzbekistan [25],

Turkmenistan [26], and Tajikistan [27]. The third species *H. sinense* mainly present in yaks occurs in China [7] and was also reported from the former Tajik SSR [28].

Table 1 – Historical and current data on the prevalence of bovine hypodermosis in Kazakhstan and neighboring regions.

Country - province or region	Method	Host species	Study period	Prevalence (%) ¹	Ref.
Kazakhstan (former Kazakh SSR)	Clinical	Cattle	1949–52	77	[29]
- northern steppe zone	Clinical	Cattle	1979–81	A: 11–25 Y: 20–30	[20]
- North Kazakhstan	Clinical	Cattle	Early 1990s	1–35	[21]
- North Kazakhstan	Clinical	Cattle	2016–18	A: 8 Y: 19	[22]
- East Kazakhstan	Clinical	Cattle	End of 1970s / beginning of 1980s	20–30	[30]
- East Kazakhstan	Clinical	Cattle	2015–18	A: 22 Y: 46	[23]
- West Kazakhstan	Clinical	Cattle	1999	≈100	[31]
- eight Kazakh oblasts	Serology	Cattle	Winter 2015/16	A: 74	[32]
Kyrgyzstan	Clinical	Cattle	?	+	[24]
Uzbekistan	Clinical	Cattle	1997–98	14	[25]
Turkmenistan (former Turkmen SSR)	Clinical	Cattle	Before 1969	+	[26]
Tajikistan (former Tajik SSR)	Clinical	Yak	1966	A: 50–70 Y: 80–90	[28]
- south Tajikistan	Clinical	Cattle	Before 2021	11–31	[27]
Russia - west Siberia, Tyumen	Clinical	Cattle	2000–03 2004–09 2010–12	10–22 0.4–4 0–0.1	[33]
- Altai Republic - Kemerovo oblast	Clinical	Cattle	1993–2003	47 73	[34]
China - Xinyang province	Serology	Cattle, yak	2001–02	52	[35]

¹A: adult animals (>2 years old); Y: young animals (<2 years old); + occurring.

The available literature provides only imprecise and difficult to compare data on the prevalence (extensity) of the bovine hypodermosis in Central Asian regions. Reasons for this are that the studies were regionally limited or performed in few herds only, were from earlier periods of time only, or detailed information on sampling criteria, age of the animals examined and examination

method used was missing. Obviously, there were no province-wide or nationwide surveys to estimate the prevalence of *Hypoderma* infection. Nevertheless, the available data strongly

show that the hypodermosis is still (or already again) **widespread and common** in Kazakhstan and most other Central Asian regions (Table 1).

First-choice compounds against *Hypoderma* larvae

The first-choice compounds for the treatment of *Hypoderma*-infected cattle and yaks are currently **macrocyclic lactones**, such as ivermectin [36,37,38], doramectin [39,40], eprinomectin [41], and moxidectin [42,43], which have a nearly 100% efficacy against *Hypoderma* first-stage larvae. Depending on the formulation of the drug, they are applied either subcutaneously at a dose of 200 µg/kg bodyweight (bwt.) or pour-on at a

dose of 500 µg/kg bwt. An excellent efficacy against *Hypoderma* larvae has been also documented for the long-acting injection formulations of ivermectin ('Ivomec® Gold' [44]) and eprinomectin ('Longrange®' [45]).

In contrast, synthetic pyrethroids given as repellents are **not** sufficiently effective to protect cattle from *Hypoderma* flies and their egg deposition in summer [33].

Recommendations for a strategic control of bovine hypodermosis

Bovine hypodermosis can be successfully controlled and **eradicated from an area**, in principle [1,2]. This is also shown by recent examples from the Russian Federation [3,38,46] and China [47], where the prevalence had been reduced by government monitored and promoted control measures and several years of the consistent use of appropriate antiparasitic drugs.

Guidelines for launching a *Hypoderma* eradication program can be read in the final report on the European cooperation 'Improvements in the control methods for warble fly in livestock' [47].

In endemic regions one treatment with a macrocyclic lactone should be given to all cattle or yaks **in late October or November** (but not later, e.g. [48]) to kill the first-stage *Hypoderma* larvae and therefore to protect the animals from pain and suffering and to prevent economic losses.

When such a hypodermosis control is mandatory (as in France) or can be

coordinated on a regional or national level, and when the mentioned compounds are strictly used for **all (!) bovines** that were grazed in summer **on all (!) farms of a region**, the eradication of hypodermosis is possible within a few years [1,2].

In Canada, a *Hypoderma* control program, being supported by the government, was found to have a high benefit-cost ratio estimated at 11–17:1 [14].

Unfortunately, in Kazakhstan and other Central Asian countries the hypodermosis treatment is not mandatory but the farmers' initiative until now. Therefore, only a few farmers usually take an interest to control this disease, even if the parasites reduce the profit per animal. An eradication will **not** be achievable in such a situation. This is because re-infections in cattle herds can occur by a few untreated animals on the respective farm remaining the reservoir of the parasite and/or by recently purchased

animals from other farms that are infected with *Hypoderma* larvae.

Any hypodermosis focus may spread very rapidly as an older example from Ireland shows: this country was *Hypoderma* free until 1982, when 32 infected cattle on 7 farms were detected. Unfortunately, no treatment was applied because of the 'low prevalence'. However, a survey done in spring 1985 presented that in the meanwhile more than 2,200 cattle from 312 farms were affected [1]. Therefore, efforts should be made that an appropriate hypodermosis control program will become **mandatory** in Central Asian regions for the benefit of both cattle and farmers.

A **very cost-saving** and proven method of the treatment against *Hypoderma* first-stage larvae is the

autumn (!) application of a '**microdose of ivermectin**': 2 µg/kg bwt. subcutaneously (1/100 of the normal dose) that is 0.1 ml of the 1% injection solution to cattle or yaks regardless of bodyweight, or 2.5 µg/kg bwt. pour-on (2.5 ml of the 0.5% pour-on solution per head regardless of bodyweight) [1,2,49]. Similarly, a '**minidose of eprinomectin**' of 50 µg/kg bwt. pour-on was reported to be as effective as the approved dose of 500 µg/kg bwt. pour-on [50]. (It should be emphasized that micro- or minidoses have **not** any sufficient efficacy against other arthropod or nematode infections.) Unlike ivermectin, moxidectin given at a microdose (1 mg per head regardless of bodyweight) is **not** sufficiently effective against *Hypoderma* larvae [43].

Conclusion

Given the widespread occurrence and the negative economic impact of hypodermosis, province-wide campaigns should be initiated and supported by the government and respective authorities in Kazakhstan and elsewhere in Central Asia

to eradicate this parasitosis by appropriate control measures. This aims to improve the health and performance of cattle and to increase the economic income of the farmers.

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ҚАЗАҚСТАНДА ЖӘНЕ ОРТАЛЫҚ АЗИЯНЫҢ БАСҚА АЙМАҚТАРЫНДАҒЫ ІРІ ҚАРА МАЛДЫҢ ГИПОДЕРМОЗЫНА ҚЫСҚА ШОЛУ - ОСЫ ПАРАЗИТОЗБЕН КҮРЕСУДІҢ МЕМЛЕКЕТТІК ШАРАЛАРЫ БОЙЫНША ҰСЫНЫСТАР

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Түйін

Гиподермоз - жағымсыз экономикалық салдары бар ірі қара малдың паразитозы екені белгілі. Дегенмен, ол әлі де (немесе қайтадан) Қазақстанда және Орталық Азияның басқа аймақтарында кеңінен таралған. Бұл, негізінен, бұрынғы Кеңес Одағы ыдырағаннан кейін мал шаруашылығы өндірісін қайта құрылымдау мен жекешелендіру негізінде қалыптасқан экономикалық және әлеуметтік мәселелермен байланысты болды, олардың бір бөлігі ауыл шаруашылығында әлі де сақталуда.

Осыған орай гиподермоздың экономикаға әкелетін зардаптарын ескере отырып, малдың денсаулығын жақсарту және шағын фермерлердің кірісін өсіру үшін, жалпы алғанда ірі қара мал шаруашылығының рентабельділігін арттыру мақсатында гиподермозбен күресу шараларын жүргізу, сондай-ақ оларды мемлекеттік реттеу арқылы бақылау қажет.

Мақаланың мақсаты - осы ұсыныстың түсінігі мен негізін қамтамасыз ету. Ағылшын тіліндегі ұқсас терминдер мен *Hypoderma* түрлерінің өмірлік циклін сипаттағаннан кейін Қазақстанда және басқа Орталық Азия аймақтарында ірі қара мал гиподермозы және оның экономикалық әсері, сондай-ақ осы паразитозды бақылау және жоюдың қазіргі нұсқалары туралы қысқаша шолу беріледі.

Кілт сөздер: *Hypoderma*, гиподермоз, ірі қара мал, таралу, экономикалық әсері, бақылау, Қазақстан, Орталық Азия.

КРАТКИЙ ОБЗОР ГИПОДЕРМОЗА КРС В КАЗАХСТАНЕ И В ДРУГИХ РЕГИОНАХ ЦЕНТРАЛЬНОЙ АЗИИ - С РЕКОМЕНДАЦИЕЙ ПО БОРЬБЕ С ЭТИМ ПАРАЗИТОЗОМ ПОСРЕДСТВОМ ГОСУДАРСТВЕННЫХ МЕР

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Аннотация

Известно, что гиподермоз является паразитозом крупного рогатого скота с большими негативными экономическими последствиями. Тем не менее, он все еще (или снова) широко распространен в Казахстане и других регионах Центральной Азии. Это в основном связано с реструктуризацией и приватизацией животноводства после распада бывшего Советского Союза, что было связано с экономическими и социальными проблемами, некоторые из которых все еще сохраняются в сельском хозяйстве.

Ввиду отрицательного экономического воздействия, гиподермоз крупного рогатого скота должен контролироваться соответствующими мерами, в том числе государственными для улучшения здоровья животных и увеличения доходов мелких фермеров в частности, и рентабельности животноводства в целом.

Цель данной статьи - дать понимание и основу для этой рекомендации. После описания родственных английских терминов и жизненного цикла видов *Hypoderma* дается краткий обзор возникновения гиподермоза крупного рогатого скота в Казахстане и в других регионах Центральной Азии и его экономического воздействия, а также текущих вариантов контроля и искоренения этого паразитоза.

Ключевые слова: *Hypoderma*, гиподермоз, крупный рогатый скот, распространенность, экономические последствия, лечение, Казахстан, Средняя Азия.