



## Warble (*Hypoderma* spp.) occurrence in red and fallow deer: results of a three years long study

A. Kovács<sup>1</sup>, K. Ács<sup>2</sup>, A. Pintér<sup>3</sup>, L. Sugár<sup>3</sup>

<sup>1</sup>Pannonian University, Georgikon Faculty of Agronomy, H-8360 Keszthely, Deák F. u. 16.

<sup>2</sup>SEFAG Forest Management and Wood Industry Share Co., H-7400 Kaposvár, Bajcsy-Zs. u. 21.

<sup>3</sup>Kaposvár University, Faculty of Animal Science, H-7400 Kaposvár, Guba S. u. 40.

### ABSTRACT

*Skin bot fly larvae or warbles (hypodermosis) in European Cervidae is of high economic importance in regard of the losses for leather processing. The hides of deer shot during autumn-winter is full of the warble-holes, while the summer hides have reduced value because of the cicatrized patches. Authors examined the hypodermosis of red deer (Cervus elaphus L.) and fallow deer (Dama dama L.) in Pannonia (Western Hungary) during three consequent hunting seasons (October-February). The overall prevalence (67.9%) as well as the mean intensity (106.8 larvae/host) were relatively high, and hypodermosis has a general distribution. The prevalence in stags was 100% and in yearling hinds 97.6%, respectively. In the majority of the infected adult hinds a large number of dead larvae were present too, what should be the result of acquired immunity induced by the developing larvae in previous season(s). The low prevalence in calves is related to the time of birth (early May), thus about half of them is missing the time of oviposition. Hypodermosis is less common in fallow deer, this species seems to be an unsuitable host for Hypoderma larvae. There was no infected fawn, as they were born in early June only, when the oviposition season is over. For the purpose of the industrial quality deer leather only hides of calves/fawns are useful after careful inspection. Peroral chemotherapy against hypodermosis is contraindicated in terms of venison-contamination, ecological, nature conservational, and other problems.*

(Keywords: red deer *Cervus elaphus* L., fallow deer *Dama dama* L., hypodermosis, prevalence, intensity)

### ÖSSZEFOGLALÁS

#### Bőrbagócsok (*Hypoderma*-fajok) előfordulása gím- és dámszarvasokban: hároméves vizsgálat eredményei

<sup>1</sup>Kovács A., <sup>2</sup>Ács K., <sup>3</sup>Pintér A., <sup>3</sup>Sugár L.

<sup>1</sup>Pannon Egyetem, Georgikon Mezőgazdaság-tudományi Kar, 8360 Keszthely, Deák F. u. 16.

<sup>2</sup>SEFAG Erdészeti és Faipari Zrt., 7400 Kaposvár, Bajcsy-Zs. u. 21.

<sup>3</sup>Kaposvári Egyetem, Állattudományi Kar, 7400 Kaposvár, Guba S. u. 40.

*A szarvasfélék bőrbagócsossága igen jelentős kiesést okoz a bőrfeldolgozás szempontjából. A téli félévben elejtett bagócsos állatok bőre lyukacsos, a nyári bőrök pedig a heges foltok miatt csökkent értékűek. Az őszi-téli időszakban terítékre került dunántúli gím- és dámszarvasok bagócsosságát vizsgálták a szerzők a vadfeldolgozás folyamán két vadászidényben. Az vizsgált gímszarvasok kétharmada volt bagócsos, a fertőzöttség Dunántúl-szerte elterjedt. A bikák fertőzöttsége 100, az ünők 97,6%-os volt. A tehenek*

tehenek mérsékelt bagócsossága és az elhalt lárvák nagyszámú előfordulása az előző fertőzések hatására kialakult immunitással magyarázható. A borjak több mint fele bagócsmentes volt, ami arra utal, hogy a születések ideje és a nősténylegyek peterakási idenye csak részlegesen esik egybe. A dámszarvasok bagócsossága nem jelentős, nem megfelelő gazdái a *Hypoderma*-fajoknak. A *Hypoderma diana* előfordulása meglehetősen gyakori és általános az észleltek alapján. Ruházati célú bőrfeldolgozásra csupán a kiválogatott borjúbőrök alkalmasak. A bőrbagócsok elleni perorális beavatkozást a szerzők ételminőségügyi, ökológiai, természetvédelmi és egyéb okok miatt ellenjavaltnak tartják. (Kulcsszavak: gímszarvas *Cervus elaphus* L., dämuvad *Dama dama* L., hypodermosis, prevalencia, intenzitás)

## INTRODUCTION

Larvae of skin bot flies or grubs (Hypodermatidae) are causing subcutaneous myiasis with serious economic losses in many domestic (Bovidae) and wild (Cervidae) Eurasian ruminants. In European cervids three *Hypoderma* species occur. *H. actaeon* (Brauer, 1858) is known to be a stenoxen parasite of red deer (*Cervus elaphus* L.); in contrast *H. diana* (Brauer, 1858) may occur in all cervid species, however its main host is the roe deer (*Capreolus capreolus* L.), meanwhile *Hypoderma* (*Oedemagena*) *tarandi* is coexisting with reindeer (*Rangifer rangifer* L.) and only exceptionally developing in other deer species according to Grunin (1965) and Zumpt (1965).

We here report the findings of examining *Hypoderma* larvae occurrence in Pannonian (W.-Hungary) red deer and fallow deer (*Dama dama* L.) populations. Extensive studies on deer hypodermosis have been conducted in central Europe (Brauer, 1863; Sugár, 1976) and more recently in Spain (Martinez et al., 1990; Perez et al., 1995; San Miguel et al., 2001).

## MATERIALS AND METHODS

The study area (Pannonia, Western Hungary) is dominated by hill-country between 150–700 m a.s.l., with two major flatlands, one in the NW corner and another in the central part on the East, respectively. However, roe deer is more numerous and generally dispersed everywhere, red deer also shows an overall distribution in the area, but it usually concentrated in and around the large forest blocks. Fallow deer is common in two regions of the South, but there are some populations in the North as well. Moufflon (*Ovis ammon musimon*) has some island-like populations in the higher mountains, meanwhile wild boar (*Sus scrofa ferus* L) is common everywhere.

Carcasses were examined in Öreglak Venison Processing Plant Ltd. during two consequent hunting seasons, September–February 2007/08, 2008/09 and 2009/2010, because most of the deer shot in Pannonia is processed there. During carcass inspection it was possible to classify the host specimens like calf/fawn, yearling adult hind/doe and stag/bock according to the body size and shape, and the situation of the radius-ulna and tibia-fibula epiphysis ossification. After skinning the surface of the carcasses as well as the inner surface of the hides were examined. All living *Hypoderma* larvae were collected and taken into polyethylen-bags for laboratory investigation. The localization of larvae in relation to body parts as well as the number and status (stage, estimated time of mortality) of the dead larvae were registered, in some cases documented by digital images.

In the laboratory larvae collected from the individual carcasses/hides were classified and separated according to the larval stages such as L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>, and mature L<sub>3</sub>.

The species of the larva specimens were identified using the characteristics described and illustrated by *Grunin* (1965), *Zumpt* (1965), *Sugár* (1976), and *Papp and Szappanos* (1992). Larva specimens were put into 40% ethanol solution for the more precise morphologic examination and for documentation.

Data were taken into Microsoft Excel tables, then the prevalence (percentage of infected hosts) and mean intensity (number of larvae/infected hosts) values were calculated separately for the two hunting seasons, deer age and sex, and in total, respectively according to the definitions by *Margolis et al.* (1982). To calculate intensity alive larvae were considered only. Altogether data of 215 red deer and 197 fallow deer inspected in the two hunting seasons were analysed.

## RESULTS AND DISCUSSION

### Red deer

Characteristic data of red deer investigations are presented in *Table 1*. The overall prevalence is 67.9%. There is a little difference between the two seasons prevalence values, what is mainly resulted by the different ratios of infected adult binds and calves in the two seasons. Combined data of the two seasons show that about two-third of the adult hinds and less than half of the calves had *Hypoderma* larvae. The prevalence in yearling hinds and stags is extremely high, there was only one yearling free of larvae among 42 individuals. It is important to notice that 17 adult hinds (25.4%) had dead larvae only and another 37 had dead larva specimens beside alive ones (55.2%).

**Table 1**

### Data of red deer hypodermosis

Season(6)	All animal(1)		Hinds(2)		Stags(3)		1.5 yr old hinds(4)		Calves(5)	
	n	prev % (int)	n	prev % (int)	n	prev % (int)	n	prev % (int)	n	prev % (int)
2007/2008	60	61.7 (39.2)	24	54.2 (27.8)	-	-	22	95.5 (49.6)	14	21.4 (16.0)
2008/2009	99	72.7 (120.5)	30	76.7 (27.1)	13	100 (256.8)	17	100 (165.5)	39	48.7 (57.5)
2009/2010	56	66.1 (143.1)	13	84.6 (20)	4	100 (402.5)	9	100 (373.1)	30	43.3 (8.3)
Total	215	67.9 (106.8)	67	70.1 (25.6)	17	100 (279.3)	42	97.6 (162)	83	42.2 (39.2)

*1. táblázat: A vizsgált gímszarvasok bőrbagócsosságának az adatai*

*Összes vizsgált állat(1), Tehén(2), Bika(3), 1,5 éves ünő(4), Borjú(5), Idény(6)*

Concerning mean intensity there is an important difference among the three seasons. Looking at the different age and sex groups the intensity in adult hinds seems to be constant. In contrast the main intensity values of the three seasons differs strongly influenced by the yearling hinds' as well as calves' infection rate and intensity values. The highest value (279.3 larvae/host) was found in stags followed by yearling hinds (162).

### Fallow deer

Data of fallow-deer examinations are shown in *Table 2*. The combined prevalence is low (18.8%) and there is a strong difference among the three seasons. It is obviously resulted by the difference values found in deer older than 1.5 year, because all fawns were free of larvae.

Mean intensity is also low (6.5 larvae/host). However the single season values are much higher in 2009/2010 in contrast to the total prevalence value of the three seasons. It is worth to comment that in an important proportion (20/29) of the infected fallow deer only dead larva specimens were found.

**Table 2**

#### Main data of fallow deer hypodermosis

Season(4)	All animal(1)			≥1.5 yr old(2)			Fawns(3)		
	n	prev. %	int.	n	prev. %	int.	n	prev. %	int.
2007/08	84	4.2	20.2	51	7.8	20.25	33	0	0
2008/09	99	25.3	7.9**	77	32.5*	7.9**	22	0	0
2009/10	14	57.1	1.9	9	88.9	1.9	5	0	0
total	197	18.8	6.5**	137	27	6.5**	60	0	0

2. táblázat: A dámszarvasok bőrbagócsosságának főbb jellemzői

Összes vizsgált állat(1), ≥1,5 éves(2), Borjú(3), Idény(4)

### CONCLUSIONS

The results of this investigation confirm the previous observations of *Sugár* (1976) and *Sugár et al.* (2001) for Hungary in regard of the high prevalence of both *H. actaeon* and *H. diana* in Pannonian red deer. Surprisingly, *Perez et al.* (1995) and *San Miguel et al.* (2001) in Southern Spain found only *H. actaeon* in contrast to the previous detection of *H. diana* (*Martinez et al.*, 1990) in similar southern areas of Spain. The prevalence as well as intensity values were high in stags and yearling hinds. The lower values in adult hinds are indicating acquired immunity, what is well documented in cattle (*Baron and Colwell*, 1991; *Otranto*, 2001). On the other hand, the low prevalence in calves is related to their birth time (early May), therefore about half of them will miss the oviposition by adult flies.

Hypodermosis is less common in fallow deer, this species seems to be an unsuitable host for *Hypoderma* larvae. There was no infected fawn, as they born in early June only (one month later than the red deer calves), when the oviposition season is over.

On the basis of the findings the occurrence of *H. actaeon* and *H. diana* in Pannonia seems to be quite frequent and general. For purpose of the industrial quality deer leather only hides of calves/fawns are useful after careful inspection. Peroral chemotherapy against hypodermosis is contraindicated in terms of venison-contamination, ecological, nature conservational, and other problems.

### ACKNOWLEDGEMENTS

Authors would like to acknowledge the help of the team in Öreglak Venison Processing Plant Ltd., especially for Géza Vörös, Ferenc Takács, János Berta, György Nyers, Roland Tóth and our vet colleagues, dr. János Geszti and dr. Zoltán Tóth.

## REFERENCES

- Baron, R.W., Colwell, D.D. (1981). Mammalian immune responses to myiasis. *Parasitology Today*. 7. 353-355.
- Brauer, F. (1863.) Monographie der Oestriden. Braumüller Ed., Wien.
- Grunin, K.: Hypodermatidae. In: Lindner, E. (ed): Die Fliegen der palaearktischen Region. (1965). Schweizerbart sche Verlagsbuchhandlung. Stuttgart. 11. 1-160.
- Festetich P. (1941). Az öz tenyésztése, óvása és vadászata. Wajna és Bokor. Budapest, 1-101.
- Kertész K. (1897). A szarvasok és özek bőre alatt élő kukacokról. *A természet*. 1. 10-11.
- Király I., Egri B. (2004). A Tolna megyei őzállomány orrgaratbagócs-fertőzöttségéről. *Magyar Állatorvosok Lapja*. 126. 433-438
- Margolis, L., Esch, G.W., Holmes, J.C., Kurus, A.M., Schad, G.A. (1982). The use of ecological terms in parasitology (report and adhoc committee of the American Society of Parasitologists). *The Journal of Parasitology*. 68. 131-133.
- Martinez, F., Hernandez, S., Ruiz, P., Molina, R., Martinez, A. (1990). Hypodermosis in red deer *Cervus elaphus* in Cordoba, Spain. *Med. Vet. Ent.*, 4. 311-314.
- Otranto, D. (2001). The immunology of myiasis: parasite survival and host defensive strategies. *Trends in Parasitology*. 17. 176-182.
- Papp L., Szappanos A. (1992). Bagócslegyek. Gasterophilidae, Oestridae, Hypodematidae. *Studia Naturalia. Magyar Természettudományi Múzeum, Budapest*, 1-56.
- Perez, J.M., Granados, J.E., Ruiz Martinez, I. (1995). Studies on the Hypodermosis affecting red deer in central and southern Spain. *J. Wildlife Diseases*. 31. 488-490.
- Ridsdill-Smith, T.J. (1988). Survival and reproduction of *Musca vetustissima* Walker (Diptera: Muscidae) and a scarabeine dung beetle in dung of cattle treated with avermectin B. I. *Journal of Australian Entomological Society*. 27. 175-178.
- San Miguel, J.M., Alvarez, G., Luzon, M. (2001). Hypodermosis of red deer in Spain. *J. Wildlife Diseases*. 37. 342-346.
- Sugár, L. (1976). On the incidence of larvae of hypodermatidae in the games and wild rodents of Hungary. *Parasit. Hung.*, 9. 85-96.
- Sugár L., Garay V., Kőrös A. (2001). Dunántúli gimszarvasok bőrbagócsossága és bőralatti filáriózisa. *Vadbiológia*. 8. 31-36.
- Zumpt, F. (1965). Myiasis in man and animals in the Old World. Butterworths, London. I-XV. 1-267.

Corresponding author (*Levelezési cím*):

**László Sugár**

Kaposvár University, Faculty of Animal Science

H-7401 Kaposvár, POB. 16.

*Kaposvári Egyetem, Állattudományi Kar*

*7401 Kaposvár, Pf. 16.*

Tel.: 36-82-505-800, fax: 36-82-320-167

e-mail: sugar.laszlo@ke.hu