

# Swedish Wildlife Research *Viltrevy*

VOLUME 13 · NUMBER 3 · 1985

## Incidence of lead shot in tissues of the Bean Goose (*Anser fabalis*) wintering in South Sweden

BJÖRN JÖNSSON, JOHNNY KARLSSON  
and SÖREN SVENSSON

*Sammandrag på svenska*

Förekomsten av hagel i vävnaderna hos  
sädgås (*Anser fabalis*) under vintern  
i södra Sverige

*Published by*

SWEDISH SPORTSMEN'S ASSOCIATION

SVENSKÄ JÄGAREFÖRBUNDET

Biblioteket  
Zool. Inst.  
Lund

INCIDENCE OF LEAD SHOT IN TISSUES  
OF THE BEAN GOOSE (*ANSER FABALIS*)  
WINTERING IN SOUTH SWEDEN

By BJÖRN JÖNSSON†, JOHNNY KARLSSON\* and  
SÖREN SVENSSON\*

\*Lund University, Department of Animal Ecology, Ecology Building, S-223 62 Lund, Sweden.

Contents

Abstract . . . . .	259
Introduction . . . . .	260
Background for this study . . . . .	261
The occurrence of the Bean Goose in Sweden . . . . .	261
Methods . . . . .	262
Results . . . . .	265
Incidence of Lead Shots . . . . .	265
Number of Pellets . . . . .	266
Shot Size . . . . .	267
Discussion . . . . .	267
References . . . . .	269
<i>Sammandrag på svenska:</i>	
Förekomsten av hagel i vävnaderna hos sädgås <i>Anser fabalis</i> under vintern i södra Sverige . . . . .	270

Abstract

Two hundred Bean Geese (*Anser fabalis*) expertly shot with a rifle on their winter grazing grounds in Scania, mainly after the local hunting seasons of 1978 and 1979, were X-rayed in order to determine the wounding rate caused by shotgun hunting. We found that 41 (62 %) of 66 adults and 38 (28 %) of 134 yearlings carried lead pellets in their tissues. 45 % of the birds

had only one pellet; the maximum number was 12. The average number of pellets was 2.6 for adults and 1.9 for yearlings. Pellet diameter varied between 3 and 6.5 mm, the average and also the most frequent diameter being 4 mm. Several different populations or subspecies of Bean Geese visit Scania during different periods in the winter, and may no doubt have been exposed to shotgun hunting in several countries. At present it is not possible to determine the contribution to the lead load of geese for which hunters in different countries are responsible.

### Introduction

Shotguns are commonly and widely used in the hunting of geese and other waterfowl. It is known from studies of several bird species in many countries that this mode of hunting results in wounded birds. Some of these birds are retrieved by the hunters, but others are not found. The latter eventually either die directly from the effects of wounds, or indirectly by starvation or predation, or recover. Those who die represent the so called "crippling loss" (Hunt 1968; Grieb 1970). Finally, many birds become hit without showing any apparent reaction to the wounds. The surviving birds will continue to carry shot embedded in their tissues.

Most studies of shot-wounded waterfowl refer to ducks (e.g. Whitlock & Miller 1947; Elder 1950, 1955*a*; Hoffman 1965; Norman 1976). Surprisingly high incidence of shot pellets have also been found in the protected Bewick's Swan *Cygnus columbianus* (Evans et al. 1973).

Few studies on geese are known to us. Elder (1955*b*) examined Pink-footed *Anser brachyrhynchus*, Greylag *Anser anser*, and Canada *Branta canadensis* geese wintering in England. Adult geese of all three species showed a lead shot incidence of 37–44%. Juvenile Pinkfeet and Greylags showed an incidence of only 3–5% whereas 22% of the juvenile Canada Geese carried shot.

The Shortgrass Prairie population of the Canada Goose showed lead shot incidences of 45–65% in adults and up to 37% in yearlings (Grieb 1970). In the Lesser Snow Goose *Anser c. caerulescens* of both colour phases on the Hudson Bay breeding grounds, 28% of 276 birds carried lead pellets (Ankney 1975).

For the Barnacle Goose *Branta bernicla* breeding in Spitsbergen, the following figures in its British winter grounds apply: 20% of the

adults and a small portion of the juveniles had shot in their tissues (Owen 1980).

In summary, there has been evidence for a long time that shotgun hunting results in a varying incidence of wounded birds. The published incidence rates seem to be minimum figures as a measure of wounded birds. Whitlock and Miller (1947) examined 329 ducks bagged by hunters and found that in about 10 % of them no pellets could be found. They had been killed by one or more shots which passed cleanly through the body. It is likely that some geese also become wounded without getting any shot remaining in their bodies, but the frequency is not known.

### Background for this study

The international experience of high incidence of shot in waterfowl in general, briefly summarized above, led us to assume that Bean Geese wintering in or passing through Sweden also carried shot. Extensive hunting of geese occurs in Sweden as well as in adjacent countries where the geese either breed or stay during the non-breeding seasons, i.e. the Soviet Union, Finland, Denmark, the Netherlands and the German republics. From Sweden there is only one earlier study of shot in geese. Mellquist (1969), in a sample of 31 Bean Geese obtained from Scania in 1967 and 1968, found that 45 % carried shot in their tissues.

In the mid-seventies the Scanian Ornithological Society, in a request to the Swedish Environment Protection Board, raised the question of lead shot in geese. The Board in response to this initiated a study of the problem in 1978. The Scanian Sportsmen's Association was commissioned to investigate, in co-operation with the Scanian Ornithological Society, whether the incidence of shot in Bean Geese visiting Scania was as high as was assumed.

### The occurrence of the Bean Goose in Sweden

The Bean Goose breeds in northern Scandinavia, northern Russia and further east. At least Scandinavian and Russian birds visit South Sweden where great numbers traditionally visit Scania in autumn

and spring, and depending on the severity of the winter, also winter in varying numbers. In recent years a second important resting area during autumn migration has been established at lake Tåkern in the province of Östergötland (approx. 58°20' N).

Maximum numbers in Sweden in autumn have ranged between 40 000 and 60 000 in recent years, and the maximum at Tåkern has grown rapidly to about 35 000 geese (Nilsson & Persson 1984). The first flocks arrive in September and numbers reach a maximum in October and November. In the spring some geese stay until early April.

There is an open season in the province of Scania from 1 to 21 November. The hunters are allowed to shoot geese from one hour before sunrise to 11 a.m. daily. In the breeding area of North Sweden the open season is between 1 and 15 September. The annual hunting bag is not known, but estimates provided by the Swedish hunting statistics are 3 000 geese, and nearly all of them are shot in Scania (Svenska jägareförbundet 1979–1983).

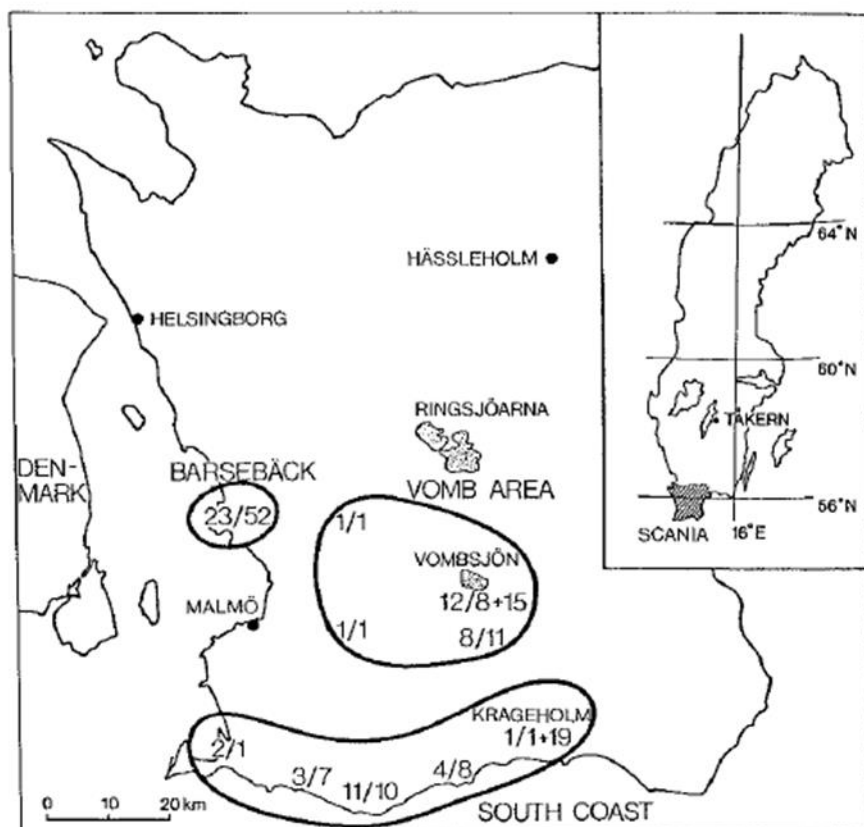
### Methods

Collection of geese was carried out by one of us (B.J.). The geese were shot with a rifle at several of the feeding areas in the southwestern parts of Scania (approx. 56°30' N; Fig. 1). Ageing (yearlings and older birds, adults, were separated) was also done by B.J. on the basis of the following criteria:

- 1) Shape of the tips of the tail feathers at the beginning of the season.
- 2) Shape and colour of the white band on the wing coverts.
- 3) The strength of the tracheal rings.

The geese were then X-rayed at the Veterinary Hospital in Malmö. The number of lead pellets in each goose was then counted from the film sheets, and the diameter of the pellet shadows was measured to the nearest 0.5 mm. The X-ray source was located 100 cm above the film. No correction of these measurements is necessary since the body of the goose is only about 20 cm high when put on the film, making the average distance between a pellet and the film about 10 cm. Thus, the diameter of the shadow is, on the average, only about 10% larger than the pellet itself.

Shooting was carried out during different periods. Most of the



**Fig. 1.** Map of Scania and Sweden (inset). Figures denote the number of geese shot at different localities. The first figure is the number of adult birds, the second the number of yearlings during and after the hunting season and the number after a plus sign (at two localities) the number of yearlings before the hunting season. — *Karta över Skåne och de områden där gäss insamlats. Siffrorna anger antalet vuxna (adultta) fåglar (första siffran) och antalet årsungar (andra siffran). Siffror efter plusstecken anger årsungar insamlade före jakt säsongen.*

geese were shot after the local hunting season, but a small sample (39 birds) was also obtained prior to the hunting season. Four birds shot during the hunting season have been pooled with the birds from after that period. Tab. 1 summarizes the sample sizes for adults and yearlings separately from the different periods. Thus, 34 yearlings were shot prior to the hunting season, and 100 yearlings and 66 adults mainly after that season, making a total of 200 geese examined.

**Table 1.** Number of Bean Geese *Anser fabalis* examined from different periods in relation to the local hunting season, 1–21 November. — *Antalet insamlade och analyserade sädgäss under olika säsonger i förhållande till jaktsäsongen (1–21 november).*

In relation to hunting season	Periods in different seasons			Totals
	1978/79	1979/80	1980	
Before		12–28 Oct.	26 Sept. – 16 Oct.	
yearlings		4	30	34
adults		5		5
During	9–13 Nov.			
yearlings	1			1
adults	3			3
After	28 Nov. – 20 Jan.	5 Dec. – 19 Jan.		
yearlings	63	36		99
adults	28	30		58
Totals				
yearlings	64	40	30	134
adults	31	35		66
all	95	75	30	200

**Table 2.** Adult Bean Geese *Anser fabalis* with lead shot in their bodies after the hunting seasons of 1978 and 1979 in the province Scania, South Sweden. Five adults shot before and three during the hunting season of 1979/80 have been included. x = with pellets; N = sample size. — *Antalet adulta sädgäss med blyhagel i kroppen efter jaktsäsongerna 1978 och 1979 i Skåne. Fem adulta fåglar skjutna före och tre under jaktsäsongen 1979/80 har inkluderats. x = antal med blyhagel; N = totala antalet undersökta individer.*

Locality	Season	Before 1 Jan.		After 1 Jan.		All season	
		x/N	%	x/N	%	x/N	%
Barsebäck	78/79	1/2		3/10		4/12	33.3
	79/80	6/6		5/5		11/11	100.0
	Both	7/8	87.5	8/15	53.3	15/23	65.2
Vomb	78/79	6/7		1/1		7/8	87.5
	79/80	9/11		2/4		11/15	73.3
	Both	15/18	83.3	3/5	60.0	18/23	78.3
South Coast	78/79	0/0		5/11		5/11	45.4
	79/80	0/0		3/9		3/9	33.3
	Both	0/0		8/20	40.0	8/20	40.0
All localities	78/79	7/9	77.8	9/22	40.9	16/31	51.6
	79/80	15/17	88.2	10/18	55.6	25/35	81.4
	Both	22/26	84.6	19/40	47.5	41/66	62.1

**Table 3.** Yearling Bean Geese *Anser fabalis* with lead shot in their tissues after the hunting seasons of 1978 and 1979 in the province of Scania, South Sweden. x = with pellets; N = sample size. — *Antalet årsungar med blyhagel i kroppen efter jaktåsongerna 1978 och 1979 i Skåne. x = antal gäss med blyhagel i kroppen; N = totala antalet undersökta individer.*

Locality	Season	Before 1 Jan.		After 1 Jan.		All season	
		x/N	%	x/N	%	x/N	%
Barsbäck	78/79	1/13		6/20		7/33	21.2
	79/80	5/11		2/8		7/19	36.8
	Both	6/24	25.0	8/28	28.6	24/52	25.9
Vomb	78/79	3/11		2/4		5/15	33.3
	79/80	0/6		0/2		0/8	0
	Both	3/17	17.6	2/6	33.3	5/23	21.7
South Coast	78/79	0/0		5/16		5/16	31.2
	79/80	0/0		4/9		4/9	44.4
	Both	0/0		9/25	36.0	9/25	36.0
All localities	78/79	4/24	16.7	13/40	32.5	17/64	26.6
	79/80	5/17	29.4	6/19	31.6	11/36	30.6
	Both	9/41	22.0	19/59	32.2	28/100	28.0

## Results

### *Incidence of Lead Shots*

The results are given in Tab. 2–4. Adult geese (Tab. 2) showed an average incidence of shotgun pellets of 62 % (52 % in 1978/79 and 71 % in 1979/80). The incidence was higher before 1 January than after (85 % vs. 48 %). In both cases the difference is significant at the 1 % level, if the samples are assumed to be random. However, groups of geese with different shot incidences probably occur, so the observed differences must be judged with caution. The number of individuals in subsamples from various localities is low, and it is therefore not possible to draw any conclusions about possible differences between localities. Geese also move quite a lot between different grazing areas (Nilsson & Persson 1984).

The yearlings (Tab. 3) had an average shot incidence of 28 % after the hunting seasons of 1978 and 1979.

For the yearlings also the small subsamples do not allow any definite conclusions about differences between early and late winter, or between localities. There was no difference between seasons. The yearlings shot before 1980 season showed the same average inci-



**Table 4.** Yearling Bean Geese *Anser fabalis* with lead shot in their bodies before the hunting seasons of 1979 and 1980 in the province of Scania, South Sweden. x = with pellets; N = sample size. — *Antalet årsungar av sädgäss med hagel i kroppen före jaktsäsongerna 1979 och 1980 i Skåne. x = antal gäss med hagel i kroppen; N = totala antalet gäss.*

Locality	Year	25 Sept. – 7 Oct.		10–28 Oct.		Whole period	
		x/N	%	x/N	%	x/N	%
Vomb	1979 and 80	2/3		2/12		4/15	26.7
Krageholm	1980	3/7		3/12		6/19	31.6
Both localities		5/10	50.0	5/24	20.8	10/34	29.4

dence, 29% as yearlings shot after the hunting season in the two previous years (Tab. 4).

#### *Number of Pellets*

The number of pellets in the geese is shown in Tab. 5. The mean number of pellets per wounded adult goose was surprisingly similar in the two seasons (2.63 and 2.60 respectively) but increased from 1.78 in 1978/79 to 2.23 in 1979/80 for the yearlings. The difference between adults and yearling (2.61–1.95) is barely statistically significant ( $p < 0.05$ ); one tailed *t*-test assuming that the number of pellets per goose is randomly distributed, and follows the Poisson distribution. Of the wounded geese 46% had only one shot in the body. None of the yearlings had more than five whereas five of the adults (12%) had more than five, one as many as twelve.

**Table 5.** Number of lead pellets in wounded Bean Geese *Anser fabalis*, collected in the wintering grounds in Scania, South Sweden, in 1978–1980. — *Antalet hagel i sädgäss på rast- och övervintringsområdena i Skåne. 1979–1980.*

		Number of pellets per individual											Mean No. of pellets per goose	
		1	2	3	4	5	6	7	8	9	10	11		12
Adults	n	19	8	5	3	1	2	1		1			1	2.61
	%	46	20	12	7	2.5	5	2.5		2.5			2.5	
Yearlings	n	17	13	2	5	1								1.95
	%	45	34	5	13	3								
All	n	36	21	7	8	2	2	1		1			1	2.29
	%	46	27	9	10	2.5	2.5	1		1			1	

**Table 6.** Frequency of pellets of different size in Bean Geese *Anser fabalis*, collected in Scania, South Sweden, in 1978–1980. — *Frekvensen hagel av olika storlek (mätta på röntgenfilmer) hos sädgäss insamlade i Skåne 1978–1980.*

		Pellet size, mm								No. of pellets
		3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	
Adults	n	15	19	38	20	10	1	1	1	105
	%	14	18	36	10	10	1	1	1	
Yearlings	n	8	12	25	11	13	1	3	0	73
	%	11	16	34	15	18	1	4	0	
All	n	23	31	63	31	23	2	4	1	178
	%	13	17	35	17	13	1	2	1	

### *Shot Size*

Details on pellet size are given in Tab. 6. Shot size varied between 3 and 6.5 mm. The majority of the shot was in the size range of 3.5 and 4.5 mm (70%), while 4 mm was the most frequent size (35%). There was no difference between adults and yearlings, and mean pellet size was also 4 mm.

## Discussion

Taking into account the probability that a certain number of the geese have been wounded at least once without any lead pellets remaining in their tissues (cf. Whitlock & Miller 1947), the observed shot incidence among the adult geese (62%), and the age-distribution that strongly affects the mean shot incidence (the majority of the adults has only experienced one or two previous hunting seasons), one can safely conclude that an old Bean Goose can almost certainly expect to be shot wounded at least once during its life.

It is possible to check the observed incidence rates of adults and yearlings against each other, provided certain assumptions about the population age structure are valid. If it is assumed that the incidence of 28% observed among yearlings after the first winter season is a typical measure of the annual shot incidence of all ages, the expected incidence for each age class can be calculated provided the annual adult mortality rate is known so that the age structure can be calculated. The adult mortality rate for the Bean Goose is 0.23

**Table 7.** Calculation of the expected adult shot incidence if the annual rate is 28% (the yearling rate). Mortality rate of adult Bean Geese is assumed to be the same (23%) as reported by Tveit (1984) from norwegian birds — *Beräkning av förväntad frekvens av sädgäss med hagel i kroppen med förutsättningen att den årliga skadskjutningen är 28% (vilket är den funna belastningen hos årsungar). Dödligheten hos vuxna sädgäss antas vara 23% som Tveit (1984) rapporterat från Norge.*

No. of hunting seasons	Shot incidence %	Age composition %	Contribution from each age class to the total theoretical incidence (percentage units)
1	28.0	23.0	6.4
2	48.2	17.7	8.5
3	62.7	13.6	8.5
4	73.1	10.5	7.7
5	80.7	8.1	6.5
6	86.1	6.2	5.3
7	90.0	4.8	4.3
8	92.8	3.7	3.4
9	94.8	2.8	2.7
10	96.3	2.2	2.1
11	97.3	1.7	1.7
>11	99.0	5.7	5.6
Totals		100.0	62.7

(Tveit 1984) which is a value very close to the one given for the very similar and closely related Pink-footed Goose (26%; Bauer & Glutz von Blotzheim 1968). In a stable population this value must equal the recruitment rate, thus giving 23% juveniles in the population, the starting value of the table. The results of the calculations are given in Tab. 7. The calculated adult lead shot incidence of 62.7% is very close to the observed one of 62.2%. It can be concluded that the yearling and adult shot incidence observed in our study are compatible with each other.

The sample of yearlings collected mainly in September and October 1980, was intended to provide a basis for an estimate of the increase of the shot incidence during the local hunting season in Scania (1–21 Nov.). The result seems to indicate that there is no increase in shot-wounded geese during the Scanian hunting season. The small sample, only 10 birds with pellets out of a sample of 34, gives very wide confidence limits even under ideal conditions. Assuming that each goose randomly selected, the 95% confidence limits are 13 and 45%. Since it is more probable that some kind of grouped samples are concerned the range of probable incidences must be still wider. Although the sample does not provide informa-

tion on the possible increase in shot load for which local hunters in Scania were responsible, it is sufficient to indicate that a proportion of the yearlings have been wounded before they arrive in Scania, probably in Finland or Russia, where the hunting season begins earlier (Lampio 1977).

### References

- Ankney, C. D. (1975). Incidence and size of lead shot in Lesser Snow Geese. *Wildlife Soc. Bull.* 3: 25–26.
- Bauer, K. M. & Glutz von Blotzheim, U. N. (1968). *Handbuch der Vögel Mitteleuropas*. Vol. 2.
- Elder, W. H. (1950). Measurement of hunting pressure in waterfowl by means of X-ray. *North Amer. Wildl. Conf. Trans.* 15: 490–504.
- Elder, W. H. (1955 a). Fluoroscopic measures of hunting pressure in Europe and North America. *N. Amer. Wildl. Conf. Trans.* 20: 298–321.
- Elder, W. H. (1955 b). Fluoroscopic measures of shooting pressure on Pink-footed and Greylag Geese. *Wildfowl Trust Ann. Rep.* 7: 123–126.
- Evans, M. E., Wood, N. A. & Kear, J. (1973). Lead shot in Bewick's Swans. *Wildfowl* 24: 56–60.
- Grieb, J. R. (1970). The shortgrass prairie Canada goose population. *Wildlife Monogr.* 22, pp. 49.
- Hoffman, L. (1965). Shooting pressure on Mallard in southern France and its seasonal evolution as studied by X-ray. *Trans. 6th Cong. Int. Union Game Biologists, Bournemouth, 1963*, pp. 271–273.
- Hunt, R. A. (1968). Shell limit and other regulations used in managed goose hunting. In: Hine, R. L. & Schoenfeld, C. (Eds.), *Canada goose management*. Dembar Educ. Inc., Madison, Wis., pp. 123–139.
- Lampio, T. (1977). Changes in the protection of waterfowl in Europe in 1969–1975. *Finnish Game Research* 36: 3–17.
- Mellquist, H. (1969). Studier av beteendet hos skadskjutna gäss. *Medd. Skånes Ornitologiska Förening* 8: 62–65.
- Nilsson, L. & Persson, H. (1984). Non-breeding distribution, numbers and ecology of Bean Goose *Anser fabalis* in Sweden. *Swedish Wildlife Research* 13: 107–170.
- Norman, F. I. (1976). The incidence of lead shotgun pellets in waterfowl (Anatidae and Rallidae) examined in south-eastern Australia between 1957 and 1973. *Aust. Wildl. Res.* 3(1): 61–71.
- Owen, M. (1980). *Wild geese of the world*. B. T. Batsford Ltd., London. 236 pp.
- Svenska jägareförbundet (1979–1983). Svenska jägareförbundets årsredogörelse 1978/1979–1982/1983. Svenska jägareförbundet, Stockholm.

- Tveit, G. (1984). Autumn migration, wintering areas and survival of Bean Geese *Anser fabalis* marked on the moulting grounds in Finmark, North Norway. *Swedish Wildlife Research* 13: 73–81.
- Whitlock, S. C. & Miller, H. J. (1947). Gunshot wounds in ducks. *J. Wildl. Managem.* 11: 279–281.

### Förekomsten av hagel i vävnaderna hos sädgås *Anser fabalis* under vintern i södra Sverige

Under vintrarna efter jaktsäsongerna 1978 och 1979 sköt vi med kula 200 (66 gamla och 134 unga) sädgäss inom tre områden i Skåne (Barsebäck, Vomb och sydkusten). Gässen röntgades varefter antalet hagel i kropparna räknades på röntgenplåtarna. Av de gamla gässen hade 62 % och av de unga hade 28 % hagel i sig. Det högsta antalet i en gås var 12 hagel. De flesta, 90 %, hade 1–4 hagel. Den vanligaste hagelstorleken (= skuggans diameter på röntgenplåten) var 4 mm. Blott ett fåtal hagel var större än 5 mm.

Undersökningen genomfördes av Skånska jägaresällskapet i samarbete med Skånes ornitologiska förening på uppdrag av statens naturvårdsverk. Den hade föranletts av misstanken att hageljakten leder till en hög andel skadskjutna gäss. En mindre svensk och flera utländska undersökningar pekade nämligen på detta. Undersökningen bekräftade misstankarna.

En teoretisk beräkning baserad på antagandet att 28 % av gässen får hagel i sig varje år (= den observerade siffran för unggäss) och att den årliga dödligheten är 23 % (enligt uppgift hos Tveit 1984) ger vid handen att 63 % av de gamla gässen kan förväntas ha hagel i sig. Siffran stämmer väl överens med det observerade värdet på 62 %. Det innebär att av 100 gäss som uppnått en ålder av 10 år bär 96 hagel i sig.

Det förelåg betydande skillnader mellan olika lokaler och olika tidpunkter. I ett stickprov om 11 gamla gäss från Barsebäck vintern 1979/80 hade samtliga hagel i kroppen, medan i ett stickprov om 8 unga gäss från Vomb samma vinter ingen hade hagel i sig. För de gamla gässen var skillnaden mellan de två vintrarna ganska stor. Den första vintern var andelen med hagel 50 % och den andra vintern så hög som 80 %. Bland unggässen fanns ingen motsvarande skillnad.

Det är för närvarande inte möjligt att fastställa hur stor andel av skadskjutningarna som jägare i olika länder svarar för, men förekomsten av hagel i unggäss från tiden före den skånska jaktens början visar som väntat att en del av gässen skadskjutits i Finland eller Ryssland, där jakten börjar tidigare.

