

Chapter 2

REPORTS OF *SALMONELLA* IN LIVESTOCK AND HUMANS

This chapter provides information on *Salmonella* isolated from livestock from samples taken on all premises, including farms, hatcheries, veterinary surgeries, zoos, slaughterhouses and human food premises. An overview of the number of incidents and isolations of *Salmonella* reported in farm animal species is given at Tables 8 & 9 and Figures 1 to 5. Poultry refer to reports from chickens, turkeys, ducks, geese and game birds.

For comparison purposes, data have been reproduced here on the number of laboratory reports of human isolations of *Salmonella* reported in England and Wales to the Health Protection Agency (HPA) Communicable Disease Surveillance Centre (CDSC) and in Scotland to the Scottish Centre for Infection and Environmental Health (SCIEH) (Tables 5 - 7). Clinical microbiology laboratories voluntarily report data and there are a number of factors which influence these reports. These are discussed in the Zoonoses Report UK 2003 (Defra 2004, in press).

Since 1998 tables have been produced comparing the relative frequency of *Salmonella* serovars in each animal species over the last five years. These data should be considered alongside absolute numbers of reports as the relative proportions may remain similar despite a change in number of reports, in which case we conclude that the change in number of reports is likely to be constant across serovars. Similarly, if there is a change in serovar relativity, it is only by examining changes in absolute numbers that we can ascertain the size of any increase or decrease. For example, in 2003 the total number of *Salmonella* incident reports increased by 17.6% compared with 2002 and increased by 1.8% compared with 2000. However, this was not consistent across serovars. Reports of *S. Typhimurium* increased by 1.4%, reports of *S. Senftenberg* fell by 39.3% and there was a small increase in the number of reports of *S. Enteritidis*. Therefore there was a change in the distribution of reports between these three serovars; the proportion of *S. Typhimurium* fell to 11.3%, the proportion of *S. Enteritidis* was little changed at 1.8% of all incidents and the proportion of *S. Senftenberg* reports decreased to 2.2% of all incidents. *S. Dublin* was, for the fourth year running, the most commonly isolated serovar from livestock in 2003, responsible for almost one third of reports. *S. Typhimurium* was the second most common type (11.3%). In 2003, *S. Livingstone* was the third, *S. enterica diarizonae* subspecies the fourth and *S. Indiana* the fifth most common.

Some serovars of *Salmonella* can infect a wide variety of host species, for example, *S. Typhimurium*. Others tend to be associated with particular animal species, for example, *S. Enteritidis* and poultry, *S. Dublin* and cattle

and *S. enterica diarizonae* subspecies and sheep. Thus the serovar distribution reflects the species distribution of reports. In 2003, 47.2% of reports were from poultry, 34.1% from cattle, 6.1% from pigs and 8.2% from sheep (see Figure 1). There were 28 reports of *Salmonella* from horses in 2003 and a single report from rabbits. There were no reports from either deer or goats in 2003.

Changes in the number of incidents have to be treated with caution in view of the inherent biases associated with the data collection. In particular, in 2001 the livestock industry was affected by an epidemic of Foot and Mouth Disease resulting in fewer clinical specimens being submitted for examination.

Tables 8 & 9 and Fig 1 show that in 2003 the total number of incidents of *Salmonella* reported rose by 471 (17.6%) compared with 2002 and increased by 985 (45.5%) compared with 2001.

The changes in the number of reports relating to cattle, pigs and turkeys mirrored those seen in livestock as a whole, but the number of reports from game birds and chickens fell compared with both 2002 and 2001 and the number of reports from sheep increased.

The relative frequency of reports of *S. Enteritidis* in 2003 (1.8%) was similar to 2002 (1.1%). There were 11 reports of *S. Enteritidis* in cattle, three reports in sheep, two reports each in pigs and horses, 6 in ducks and 36 in chickens in 2002. The decline in reports of *S. Enteritidis* which has been seen over the previous five years was reversed in 2003, specifically in chickens.

The frequency of reports of *S. Typhimurium* fell to 11.3% of all reports in 2003. The relative frequency of *S. Typhimurium* was reduced in cattle, sheep, chickens and turkeys, and little changed in pigs. There was a small increase in frequency of *S. Typhimurium* DT104 (53.2% of all STM reports) in cattle in 2003. *S. Typhimurium* DTs 166 and 169 and *S. Typhimurium* U311 were isolated in cattle for the first time since recording began in 1985. *S. Typhimurium* U315 was isolated from pigs for the first time since recording began in 1985.

The number of incidents of *S. Dublin* reported in cattle increased by 20.3% in 2003, much of which was due to an increase in reports from cattle of unknown age. The proportion of incidents of *S. Dublin* in cattle also increased in 2003 and this serovar was again the most common reported in cattle (78.9%).

Salmonella Virchow is a serovar often isolated from human cases of salmonellosis in Great Britain in, but is less frequently isolated from

livestock and only 88 incident reports were recorded in 2003 (2.8% of all *Salmonella* incidents in livestock) (Table 8). However, reports of *S. Virchow* increased in chickens and turkeys in 2003 to 9.3% and 4.2% of all incidents respectively.

Reports of *S. enterica* subspecies *diarizonae* (mainly from sheep) rose by 24% and for the fifth year running *S. enterica* subspecies *diarizonae* 61:k:1,5(7) was the most common serovar isolated from sheep (53.7%).

These trends and others are highlighted further in the relevant species sections.

Table 5 ranks the most common *Salmonella* serovars isolated from livestock in Great Britain in 2003 against the most common serovars isolated from human cases of salmonellosis in Great Britain. Tables 6 and 7 provide a similar comparison for phage types of *S. Typhimurium* and *S. Enteritidis* in livestock and humans. Apart from *S. Typhimurium* and *S. Enteritidis* the other serovars associated with human cases are reported relatively rarely from British livestock. The total number of isolation reports to the HPA from human cases of salmonellosis increased by 3.8% in 2003.

Perhaps the most important factor which may bias the number of *Salmonella* reports is the submission rate. This report presents numerator data but the denominator, in most cases, is unknown and may change over time. Most *Salmonella* incident reports from cattle, sheep and pigs result from the investigation of clinically diseased animals. Economic factors may exert a strong influence on diagnostic practices, such as whether a veterinary surgeon is consulted and whether samples are submitted for laboratory examination, and 2003 again saw a depressed livestock industry.

Diagnostic submissions to the Veterinary Laboratories Agency (VLA) and the Scottish Agricultural Colleges (SAC) have declined in recent years and were particularly affected in 2001 by the epidemic of Foot and Mouth Disease during which the testing of carcass samples from all areas and all samples from infected areas was suspended for a number of months (see Introduction). Despite increases in the number of submissions received in 2003 compared with 2002, over the five year period since 1999 cattle submissions have fallen by 7.1% and sheep submissions by 4.9%. Submissions from pigs have continued to decline steadily since 1998 (by 17.8% over the five year period) (VLA 2004). Additionally as most of the data from species other than poultry relate to clinical investigations, the prevalence of subclinical infection in these species of livestock is not usually known. A targeted national abattoir survey provides data for the period 1999 – 2000 on the prevalence of *Salmonella* in prime cattle, sheep

and pigs at slaughter in GB. Results of this survey are given in Chapter 3. Results of a similar survey conducted in 2003 will be available in late 2004.

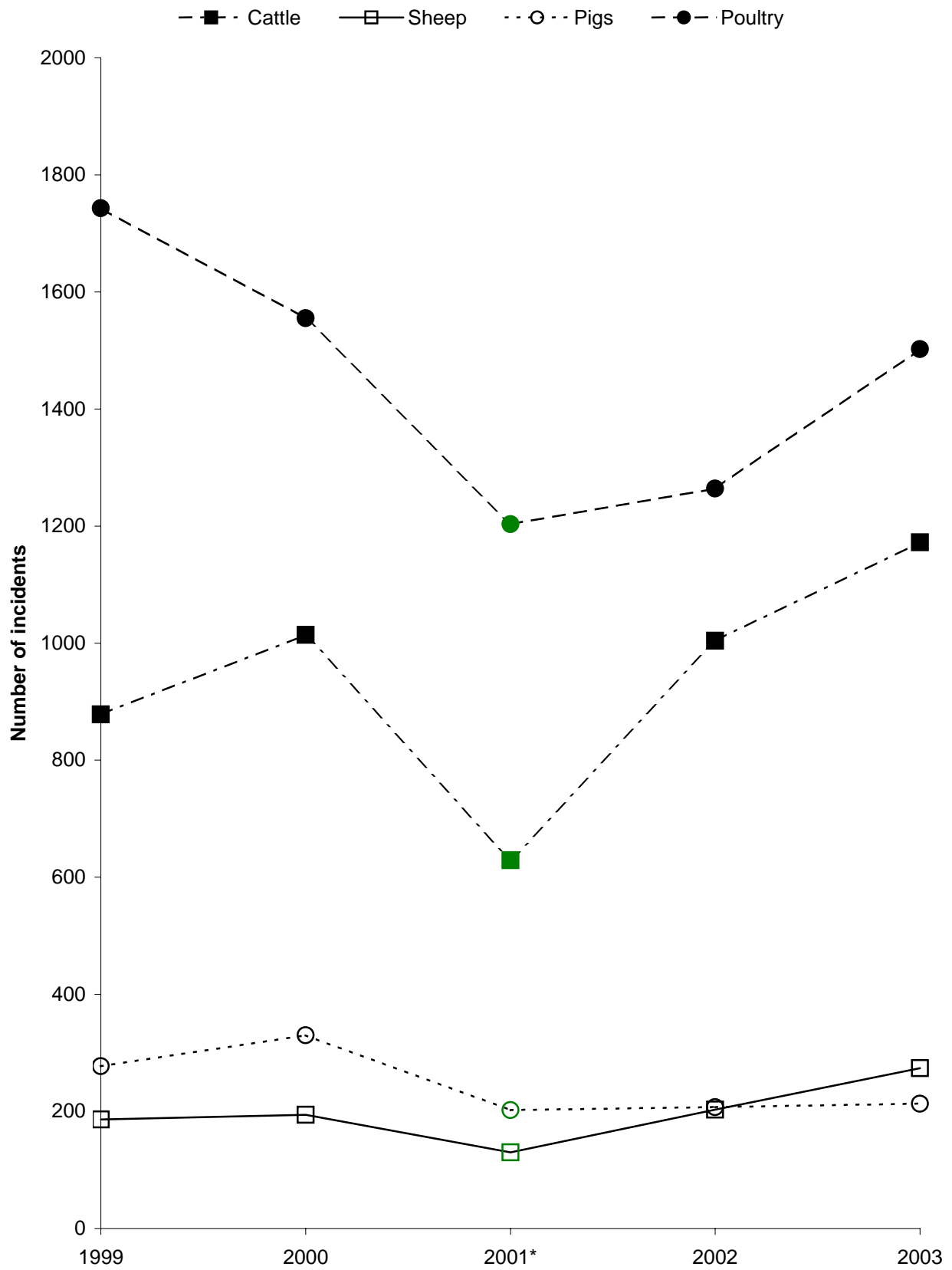
Changes in the denominator population for *Salmonella* reports from poultry, particularly chickens, turkeys and ducks, are difficult to assess and most sample submissions are associated with statutory or voluntary surveillance activities. Statutory monitoring of chicken breeding flocks for *Salmonella* detailed in the PBFHO 1993 has been supplemented by additional voluntary testing of many flocks in recent years. Turkeys and duck breeding flocks undertake voluntary monitoring for *Salmonella* following protocols in the PBFHO 1993 and there is also some voluntary monitoring in production flocks. Therefore, it is likely that there has been an increase in surveillance of poultry flocks for *Salmonella* over the five year period. Of particular note is the continued increase in surveillance of duck flocks for *Salmonella* over the past two years. The assessment of submission rates in poultry is further complicated by the large proportion of *Salmonella* testing undertaken by private laboratories. In 2003, the total number of poultry diagnostic submissions (to VLA/SAC laboratories) remained static having fallen in 2002 to the lowest level ever recorded.

Although trends in *Salmonella* reports can be compared with diagnostic submission rates to VLA/SAC it should be remembered that not all submissions will have been examined for *Salmonella*. Private laboratories also report the isolation of *Salmonella* and the total number of submissions to these laboratories is unknown.

Livestock population data are reported by the June Agricultural Census and trends in *Salmonella* reports can be compared with changes in the animal populations by consulting these data. The numbers of cattle, sheep and pigs in Great Britain fell in 2003 but there was an increase in the numbers of poultry.

The VLA *Salmonella* database has clearly identified past epidemics of *Salmonella* strains in livestock including *S. Enteritidis* PT4 (Fig 33) in chickens and *S. Typhimurium* DT104 (Fig 7) in cattle both of which are still in decline.

Fig 1: Number of incident reports of *Salmonella* in livestock (1999 - 2003)



* 2001 data may not be comparable due to uncertain impact of FMD epidemic

Table 5: Reports of the most common *Salmonella* serotypes in 2003 in livestock and humans in GB

Human cases			Cattle			Sheep			Pigs			Poultry		
Serotype	No. isolations	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%
Enteritidis	10469	64.9	Dublin	924	78.8	<i>Enterica diarizonae</i> subssp	157	57.3	Typhimurium	153	71.8	Livingstone	165	11.1
Typhimurium	2205	13.7	Typhimurium	126	10.8	Dublin	42	15.3	Derby	28	13.1	Indiana	145	9.8
Virchow	255	1.6	Anatum	31	2.6	Montevideo	26	9.5	Kedougou	7	3.3	Montevideo	102	6.9
Braenderup	179	1.1	Agama	13	1.1	Agama	13	4.7	Reading	6	2.8	Virchow	87	5.9
Newport	157	1.0	Enteritidis	11	0.9	Derby	11	4.0				Mbandaka	74	5.0
Hadar	147	0.9				Typhimurium	11	4.0				Senftenberg	70	4.7
Agona	145	0.9										Binza	68	4.6
Infantis	134	0.8										Typhimurium	63	4.2
Stanley	118	0.7										Kedougou	62	4.2
Paratyphi B var Java	104	0.6										Hadar	49	3.3
Other serotypes	2228	13.8	Other serotypes	67	5.7	Other serotypes	14	5.1	Other serotypes	19	8.9	Orion	48	3.2
												Other serotypes	553	37.2
Total	16141		Total	1172		Total	274		Total	213		Total	1486	

* Reports to Health Protection Agency and Scottish Centre for Infection and Environmental Health, provisional data

Table 6: Reports of the most common *Salmonella* Typhimurium definitive types in 2003 in livestock and humans in GB

Human cases			Cattle			Sheep			Pigs			Poultry		
DT	No. isolations	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%
104	467	21.2	104	67	53.2	104	6	54.5	U288	51	33.3	104	40	48.8
193	196	8.9	U302	11	8.7	41	3	27.3	193	25	16.3	8	10	12.2
104b	153	6.9	104b	7	5.6				104	19	12.4			
U277	152	6.9	U310	6	4.8				U302	16	10.5			
RDNC	140	6.3	12	5	4.0				RDNC	7	4.6			
193a	116	5.3	193	4	3.2				104b	4	2.6			
U302	87	3.9												
U311	57	2.6												
49	56	2.5												
U288	44	2.0												
Other DTs	737	33.4	Other DTs	26	20.6	Other DTs	2	18.2	Other DTs	31	20.3	Other DTs	32	39.0
Total	2205		Total	126		Total	11		Total	153		Total	82	

* Reports to Health Protection Agency and Scottish Centre for Infection and Environmental Health, provisional data

Table 7: Reports of the most common *Salmonella* Enteritidis phage types in 2003 in livestock and humans in GB

Human cases*			Cattle			Sheep			Pigs			Poultry		
PT	No. isolations	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%
4	2874	27.5	13a	5	45.5							4	20	45.5
1	2175	20.8										6	7	15.9
14b	959	9.2										9b	6	13.6
21	752	7.2										6a	5	11.4
6	737	7.0												
8	481	4.6												
6a	479	4.6												
12	198	1.9												
5c	152	1.5												
24	140	1.3												
Other PTs	1552	14.8	Other PTs	6	54.5	Other PTs	3	100.00	Other PTs	2	100.00	Other PTs	6	13.6
Total	10469		Total	11		Total	3		Total	2		Total	44	

* Reports to Health Protection Agency and Scottish Centre for Infection and Environmental Health, provisional data

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Agama	36	(52)	36	(42)	23	(31)	24	(32)	32	(37)
Agona	38	(49)	62	(71)	66	(82)	19	(20)	37	(39)
Ajiobo	1	(1)	3	(3)	1	(1)	4	(4)	2	(2)
Anatum	11	(14)	8	(13)	10	(11)	20	(31)	37	(46)
Ank	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Bovis morbificans	5	(5)	-	(-)	2	(2)	1	(1)	-	(-)
Bardo	2	(4)	-	(-)	-	(-)	-	(-)	-	(-)
Binza	58	(77)	51	(67)	60	(66)	100	(134)	62	(81)
Braenderup	10	(14)	3	(3)	1	(1)	1	(1)	2	(2)
Brandenburg	11	(13)	4	(4)	4	(4)	1	(1)	8	(18)
Bredeney	52	(62)	55	(60)	6	(6)	15	(17)	18	(18)
Carmel	1	(2)	-	(-)	-	(-)	-	(-)	-	(-)
Carno	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Cerro	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Champaign	-	(-)	2	(2)	-	(-)	-	(-)	-	(-)
Cholerae-suis	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Cholerae-suis-vk	2	(2)	-	(-)	1	(1)	-	(-)	-	(-)
Corvallis	-	(-)	-	(-)	-	(-)	-	(-)	3	(3)
Cubana	2	(2)	-	(-)	1	(1)	-	(-)	1	(1)
Derby	80	(109)	81	(122)	73	(93)	40	(45)	69	(96)
Dublin	488	(657)	684	(914)	441	(559)	809	(1030)	966	(1207)
Durham	1	(2)	-	(-)	2	(2)	-	(-)	2	(2)
Ealing	2	(2)	-	(-)	1	(1)	-	(-)	-	(-)
Eimsbuettel	4	(4)	-	(-)	6	(7)	1	(1)	-	(-)
Enteritidis	89	(118)	41	(55)	26	(27)	30	(37)	58	(73)
Fischerkietz	2	(2)	17	(21)	2	(3)	1	(1)	-	(-)
Give	36	(47)	148	(164)	19	(19)	32	(32)	28	(30)
Goldcoast	15	(22)	20	(29)	10	(12)	21	(24)	20	(22)
Hadar	46	(53)	46	(60)	8	(10)	48	(56)	50	(56)
Havana	2	(2)	1	(1)	3	(3)	4	(6)	17	(18)
Heidelberg	49	(56)	75	(98)	52	(60)	24	(24)	3	(3)
Idikan	6	(6)	-	(-)	1	(1)	1	(1)	1	(1)
Indiana	31	(46)	26	(34)	34	(41)	81	(115)	145	(176)
Infantis	10	(11)	4	(5)	5	(9)	7	(7)	11	(11)
Kedougou	114	(132)	98	(103)	60	(68)	74	(85)	86	(96)
Kentucky	9	(18)	16	(23)	10	(15)	3	(4)	-	(-)
Kimuenza	-	(-)	-	(-)	-	(-)	1	(1)	2	(4)
Kissi	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Kottbus	12	(15)	20	(21)	18	(20)	11	(11)	32	(41)

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	1999	2000	2001*	2002	2003
ENTERICA ENTERICA					
Larochelle	33 (35)	21 (24)	2 (2)	3 (3)	1 (1)
Lexington	1 (1)	- (-)	1 (1)	1 (1)	- (-)
Lille	1 (1)	- (-)	1 (1)	- (-)	- (-)
Liverpool	29 (33)	31 (31)	60 (73)	31 (35)	26 (27)
Livingstone	88 (112)	54 (68)	75 (90)	137 (220)	170 (199)
London	- (-)	2 (2)	1 (1)	5 (5)	2 (2)
Manhattan	9 (18)	2 (3)	- (-)	- (-)	2 (2)
Mbandaka	134 (161)	45 (56)	60 (80)	55 (62)	47 (54)
Meleagridis	1 (1)	- (-)	- (-)	1 (1)	2 (2)
Menston	- (-)	- (-)	- (-)	- (-)	1 (1)
Montevideo	114 (150)	107 (170)	114 (162)	86 (145)	139 (155)
Muenchen	- (-)	1 (1)	- (-)	1 (1)	- (-)
Muenster	5 (5)	- (-)	- (-)	- (-)	- (-)
Nagoya	- (-)	- (-)	1 (1)	2 (2)	2 (2)
New Brunswick	1 (1)	- (-)	1 (1)	- (-)	- (-)
Newington	3 (4)	- (-)	2 (2)	- (-)	- (-)
Newport	58 (74)	45 (56)	31 (35)	42 (48)	44 (48)
Ohio	75 (104)	35 (65)	23 (27)	38 (49)	33 (33)
Orion	17 (17)	9 (11)	11 (14)	53 (76)	42 (44)
Oslo	- (-)	- (-)	- (-)	- (-)	4 (6)
Panama	5 (6)	4 (5)	1 (1)	2 (2)	- (-)
Paratyphi B var java	- (-)	1 (1)	- (-)	- (-)	3 (3)
Poona	4 (4)	3 (3)	1 (1)	- (-)	1 (1)
Pullorum	13 (13)	3 (3)	4 (4)	4 (4)	2 (2)
Reading	2 (3)	3 (3)	1 (1)	5 (5)	7 (7)
Redhill	1 (1)	- (-)	- (-)	- (-)	- (-)
Rubislaw	- (-)	1 (1)	- (-)	- (-)	- (-)
Ruiru	- (-)	1 (2)	- (-)	- (-)	- (-)
Saint Paul	4 (4)	5 (5)	5 (5)	5 (5)	3 (3)
Schwarzengrund	1 (1)	7 (8)	5 (6)	2 (4)	2 (2)
Senftenberg	187 (262)	270 (368)	154 (274)	117 (160)	71 (74)
Stanley	1 (1)	- (-)	- (-)	3 (3)	2 (2)
Stanleyville	1 (1)	- (-)	- (-)	- (-)	- (-)
Stourbridge	- (-)	- (-)	- (-)	- (-)	3 (3)
Taksony	1 (1)	- (-)	2 (2)	2 (2)	- (-)
Teddington	- (-)	- (-)	1 (1)	- (-)	- (-)
Tennessee	4 (4)	- (-)	1 (1)	4 (4)	7 (4)
Thomasville	1 (1)	- (-)	1 (1)	- (-)	- (-)
Thompson	79 (91)	78 (80)	60 (60)	35 (36)	14 (16)
Typhimurium	700 (1042)	614 (814)	400 (463)	369 (450)	356 (436)

Table 8: *Salmonella* in cattle, sheep, pigs and poultry on all premises

<i>Salmonella</i> Incidents (Isolations)	1999	2000	2001*	2002	2003
ENTERICA ENTERICA					
Vejle	- (-)	- (-)	- (-)	4 (8)	3 (4)
Virchow	31 (39)	32 (35)	25 (26)	48 (49)	88 (92)
Wangata	- (-)	- (-)	- (-)	1 (1)	- (-)
Worthington	1 (1)	3 (3)	1 (1)	- (-)	1 (1)
Yoruba	- (-)	- (-)	- (-)	- (-)	1 (1)
ENTERICA DIARIZONAE					
61:k:1,5	51 (53)	47 (49)	10 (10)	22 (22)	9 (9)
61:k:1,5,7	17 (17)	50 (50)	24 (26)	78 (80)	118 (120)
61:k:1,7	- (-)	- (-)	- (-)	1 (1)	1 (1)
61:-:1,5	8 (8)	11 (11)	3 (3)	24 (26)	1 (1)
61:-:1,5,7	11 (11)	7 (8)	21 (23)	4 (4)	30 (31)
61:-:1,7	- (-)	- (-)	- (-)	- (-)	1 (1)
unspecified "arizona" +	1 (1)	- (-)	- (-)	- (-)	- (-)
ENTERICA HOUTENAE					
43:z4z23	- (-)	- (-)	1 (1)	- (-)	- (-)
UNSPECIFIED					
untypeable	- (-)	1 (1)	- (-)	- (-)	1 (1)
structure only	149 (178)	76 (82)	100 (125)	104 (120)	214 (234)
rough strain	10 (10)	11 (12)	11 (11)	10 (10)	2 (2)
untyped	8 (9)	10 (10)	1 (1)	5 (6)	- (-)
TOTAL	3086 (4079)	3093 (3958)	2164 (2725)	2678 (3372)	3149 (3683)

* 2001 data may not be comparable due to impact of FMD epidemic

+ antigenic structure not stated

Fig 2: Incidents of *Salmonella* serotypes in cattle, sheep, pigs & poultry in 2003

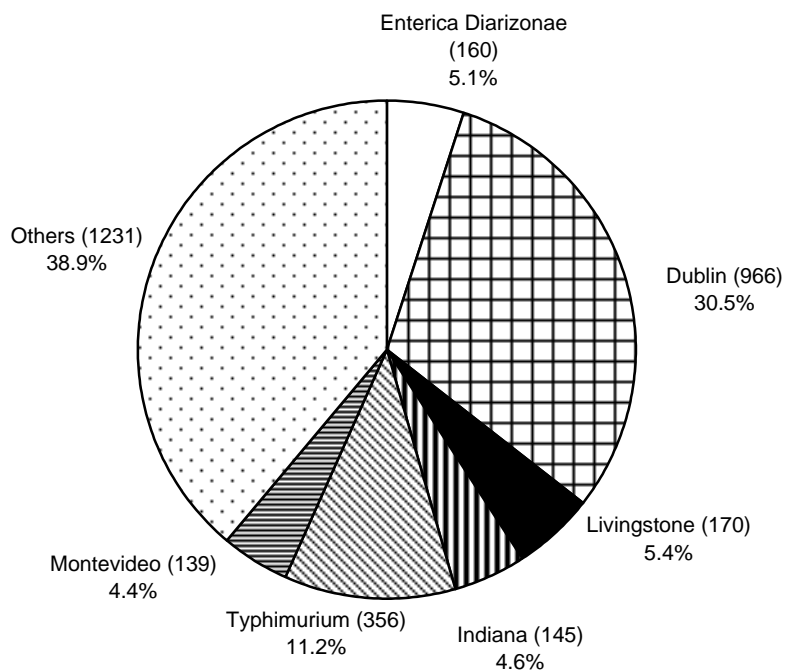
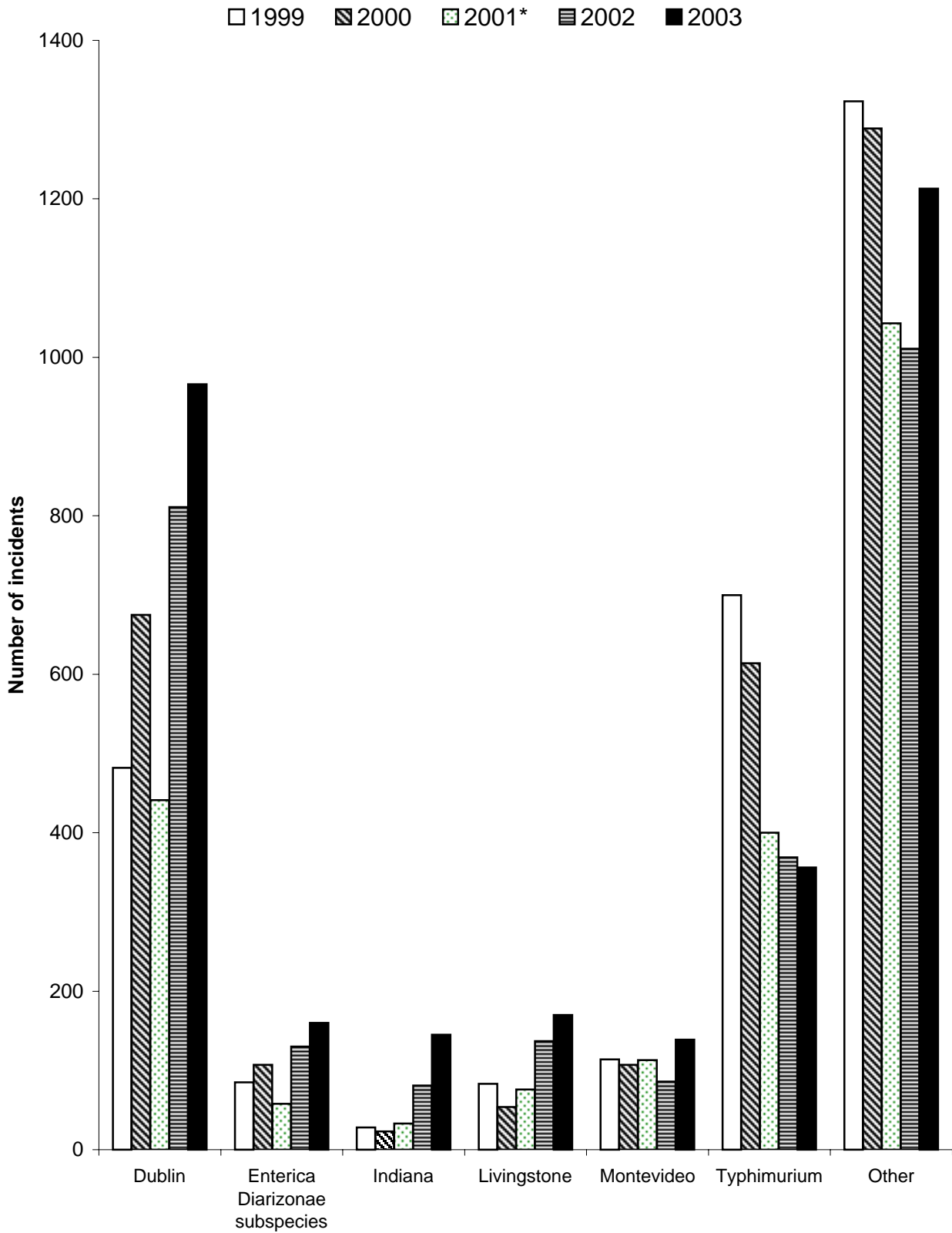


Table 9: Incidents of the top 5 *Salmonella* serotypes in cattle, sheep, pigs and poultry in 2003 as a % of all incidents compared to previous years

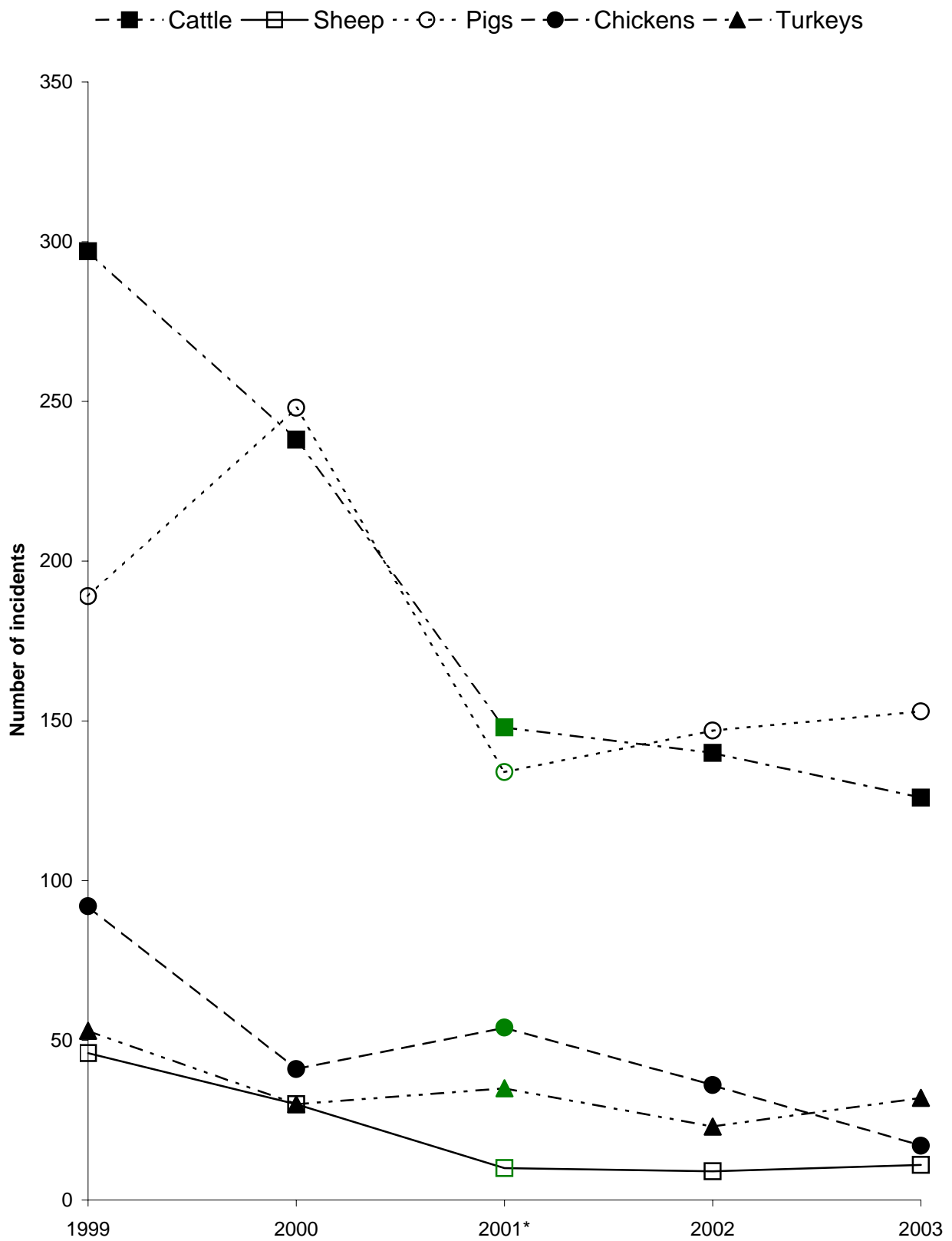
Serotype	1999	2000	2001	2002	2003
S. Dublin %	15.8	22.1	20.4	30.2	30.7
S. Typhimurium %	22.7	19.9	18.5	13.8	11.3
S. Livingstone %	2.9	1.7	3.5	5.1	5.4
S. <i>Enterica Diarizonae</i> subspecies %	2.9	3.7	2.7	4.8	5.1
S. Indiana %	1.0	0.8	1.6	3.0	4.6
Total no. incidents	3086	3093	2164	2678	3149

Fig 3: Incidents of *Salmonella* serotypes in cattle, sheep, pigs & poultry 1999 - 2003



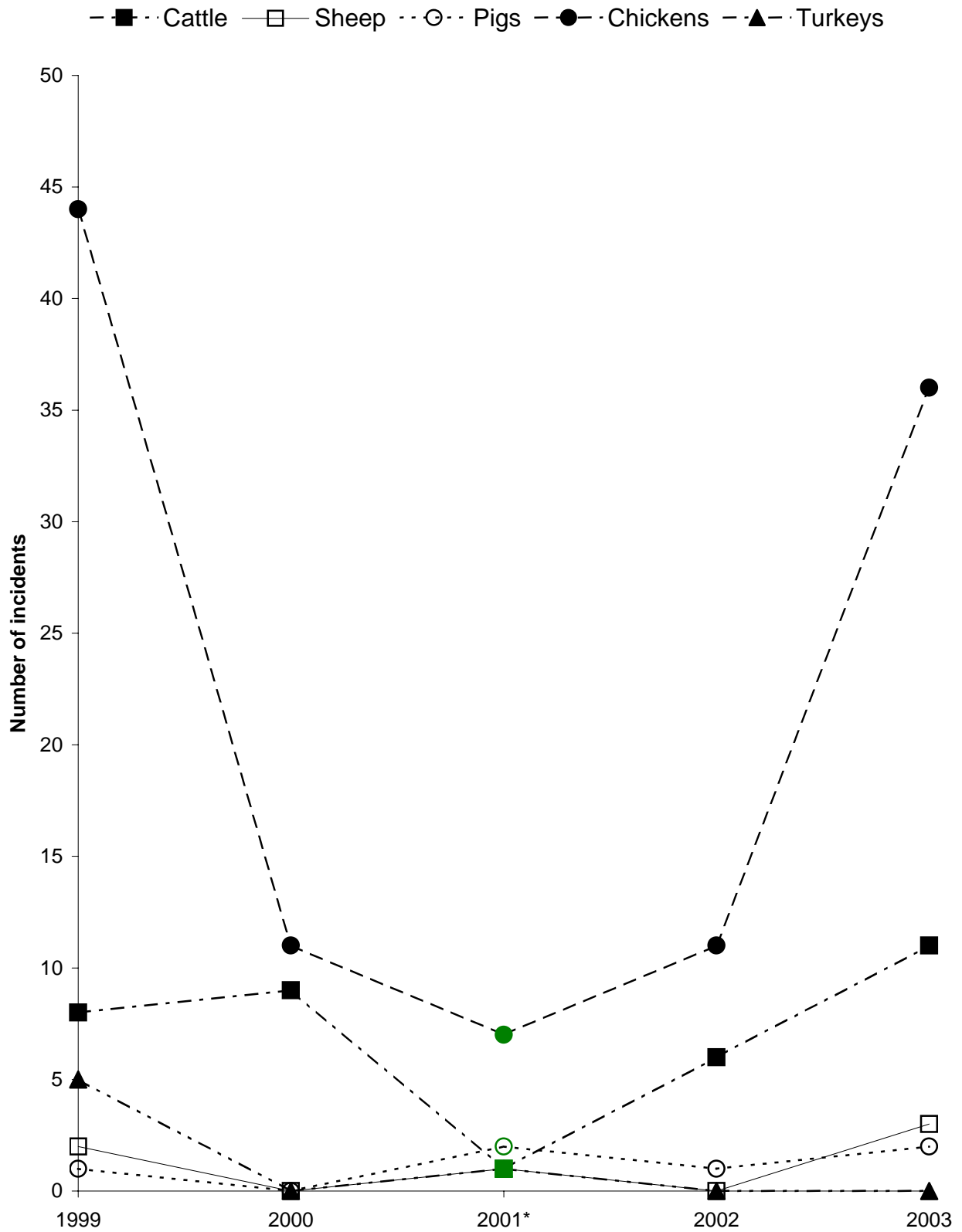
* 2001 data may not be comparable due to uncertain impact of FMD epidemic

Fig 4: Number of incident reports of *Salmonella* Typhimurium in livestock (1999 - 2003)



* 2001 data may not be comparable due to uncertain impact of FMD epidemic

Fig 5: Number of incident reports of *Salmonella* Enteritidis in livestock (1999 - 2003)



* 2001 data may not be comparable due to uncertain impact of FMD epidemic