

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) Centre for Infections (CfI) 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 that influence these reports. These are discussed in the Zoonoses Report UK 2004 (Defra 2005, in press).

For the last seven years 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 2004 the total number of *Salmonella* incident reports decreased by 13% compared with 2003 and increased by 5% compared with 2002. However, this was not consistent across serovars. Reports of *S. Typhimurium* fell by 18.2%, reports of *S. Livingstone* increased by 23.9% and there was a small increase in the number of reports of *S. Indiana*. Therefore there was a change in the distribution of reports between these three serovars; the proportion of *S. Typhimurium* fell to 10.5%, the proportion of *S. Indiana* showed a small increase at 5.5% of all incidents and the proportion of *S. Livingstone* reports increased to 8.3% of all incidents. *S. Dublin* was, for the fifth year running, the most commonly isolated serovar from livestock in 2004, responsible for almost one third of reports. *S. Typhimurium* was the second most common type (10.5%). In 2004, *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 2004, 46.4% of reports were from poultry, 32.8% from cattle, 5.3% from pigs and 9.2% from sheep (see Figure 1). There were 48 reports of *Salmonella* from horses in 2004 and no reports from deer, goats or rabbits.

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 2004 the total number of incidents of *Salmonella* reported fell by 444 (13.1%) compared with 2003 and increased by 277 (10.3%) compared with 2002.

The relative frequency of reports of *S. Enteritidis* in 2004 (0.8%) was similar to 2003 (1.8%). There were four reports of *S. Enteritidis* in cattle, six in ducks, one in geese and 12 in chickens in 2004.

The frequency of reports of *S. Typhimurium* fell to 10.5% of all reports in 2004. The relative frequency of *S. Typhimurium* was reduced in sheep, pigs and chickens, and increased in cattle and turkeys. There was a small decrease in frequency of *S. Typhimurium* DT104 (54.3% of all STM reports) in cattle in 2004. There were no new definitive types of *S. Typhimurium* reported in cattle in 2004, and *S. Typhimurium* DTs 166 and 169 and *S. Typhimurium* U311 which were isolated in cattle for the first time in 2003 were not reported again in 2004.

The number of incidents of *S. Dublin* reported in cattle decreased by 18.9% in 2004, much of which was due to a fall in reports from adult cattle. The proportion of incidents of *S. Dublin* in cattle also decreased in 2004 although this serovar was again the most common reported in cattle (73.1%).

Salmonella Virchow is a serovar often isolated from human cases of salmonellosis in Great Britain, but is less frequently isolated from livestock and only 41 incident reports were recorded in 2004 (1.4% of all *Salmonella* incidents in livestock) compared with 87 incidents (2.6%) in 2003 (Table 8).

Reports of *S. enterica* subspecies *diarizonae* (mainly from sheep) rose by 13.4% and for the sixth year running *S. enterica* subspecies *diarizonae* 61:k:1,5(7) was the most common serovar isolated from sheep (67.5%).

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 2004 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 decreased by 14.1% in 2004.

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 2004 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). The total number of diagnostic submissions received in 2004 decreased by 10.9% compared with 2003 and, over the five year period since 2000 cattle submissions have fallen by 11.9% and sheep submissions by 1.7%. Apart from an increase in 2002, submissions from pigs have declined steadily since 2000 (by 26.3% over the five year period). 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 2003 on the prevalence of *Salmonella* in prime cattle, sheep and pigs at slaughter in Great Britain. Results of this survey are given in Chapter 3.

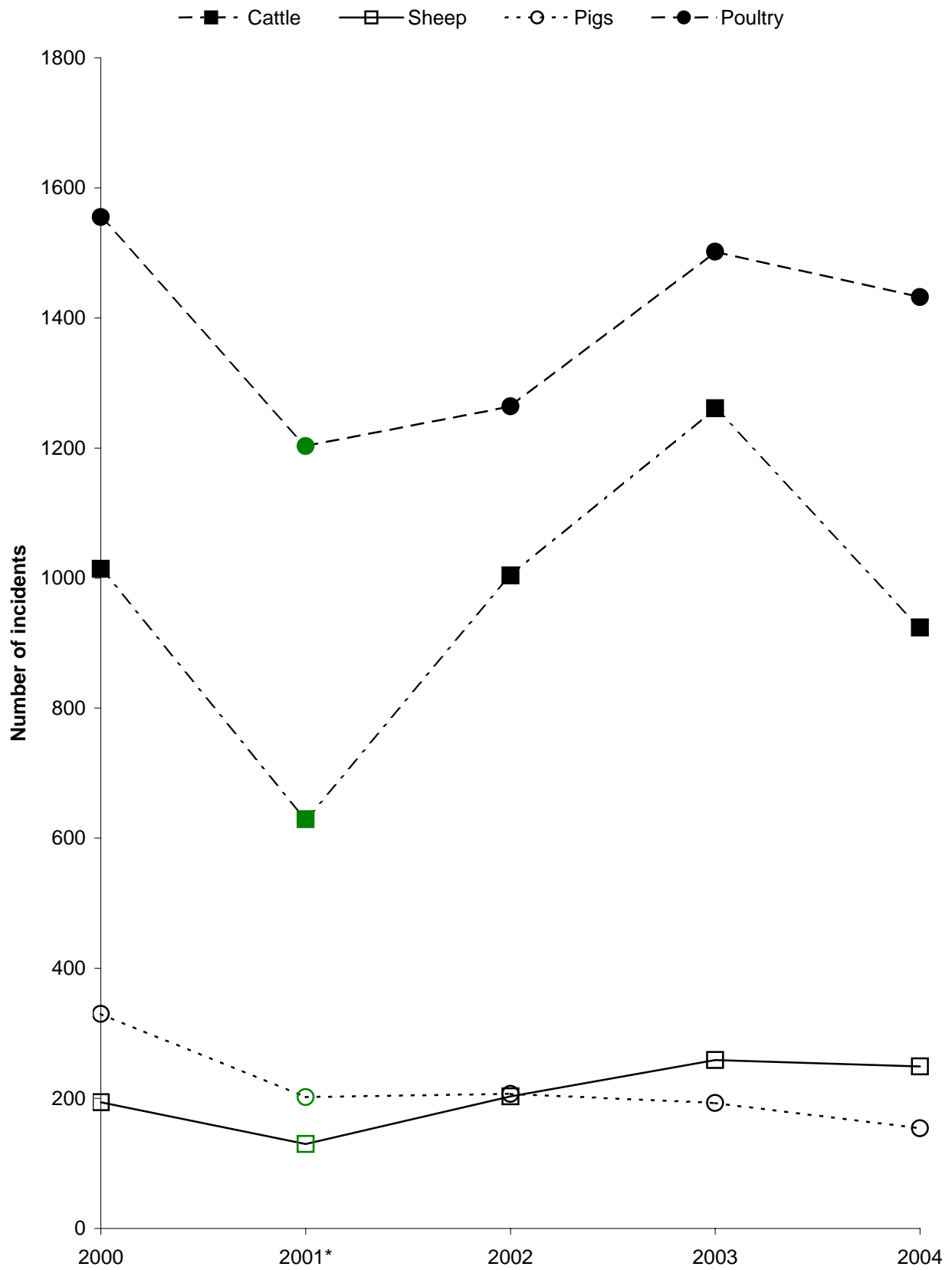
Changes in the denominator population for *Salmonella* reports from poultry, particularly chickens, turkeys and ducks, are difficult to assess and most sample submissions are associated with statutory or voluntary surveillance activities. Statutory monitoring of chicken breeding flocks for *Salmonella* detailed in the PBFHO 1993 has been supplemented by additional voluntary testing of many flocks in recent years. Turkey

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 2004, the total number of poultry diagnostic submissions (to VLA/SAC laboratories) increased by 12%.

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. In 2004, there was an increase in the numbers of cattle, sheep, pigs and poultry in Great Britain compared with 2003.

Fig 1: Number of incident reports of *Salmonella* in livestock (2000 - 2004)



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

Table 5: Reports of the most common *Salmonella* serotypes in 2004 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	8810	63.5	Dublin	780	73.1	<i>Enterica diarizonae</i> subssp	185	67.5	Typhimurium	105	64.8	Livingstone	243	16.9
Typhimurium	1486	10.7	Typhimurium	140	13.1	Montevideo	36	13.1	Derby	27	16.7	Indiana	162	11.3
Newport	677	4.9	Anatum	31	2.9	Dublin	18	6.6	Reading	6	3.7	Binza	90	6.3
Virchow	283	2.0	Montevideo	17	1.6	Derby	10	3.6	Goldcoast	5	3.1	Kedougou	83	5.8
Stanley	138	1.0	Agama	16	1.5	Typhimurium	9	3.3	Kedougou	5	3.1	Senftenberg	79	5.5
Braenderup	124	0.9										Typhimurium	58	4.0
Hadar	118	0.9										Newport	49	3.4
Agona	108	0.8										Give	44	3.1
Infantis	94	0.7										Liverpool	41	2.8
Thompson	85	0.6										Virchow	41	2.8
Other serotypes	1945	14.0	Other serotypes	83	7.8	Other serotypes	16	5.8	Other serotypes	14	8.6	Other serotypes	549	38.2
Total	13868		Total	1067		Total	274		Total	162		Total	1439	

* 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 2004 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	543	36.5	104	76	54.3	104	4	44.4	U288	56	53.3	104	34	58.6
193	65	4.4	U302	10	7.1	U288	2	22.2	193	19	18.1	8	5	8.6
104b	58	3.9	U310	9	6.4				104	10	9.5	99	5	8.6
56	48	3.2	104b	7	5.0									
RDNC	43	2.9	120	6	4.3									
U302	53	3.6	193	6	4.3									
193a	39	2.6	193a	6	4.3									
1	29	2.0	12	5	3.6									
U311	29	2.0												
Other DTs	579	39.0	Other DTs	15	10.7	Other DTs	3	33.3	Other DTs	20	19	Other DTs	14	24.0
Total	1486		Total	140		Total	9		Total	105		Total	58	

* 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 2004 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	2356	26.7	1	2	50.0							4	8	42.1
1	1968	22.3										9b	3	15.8
14b	1355	15.4										1	2	10.5
21	542	6.2										6	2	10.5
6	481	5.5												
8	366	4.2												
6a	333	3.8												
12	161	1.8												
59	109	1.2												
Other PTs	1139	12.9	Other PTs	2	50.0	Other PTs			Other PTs			Other PTs	4	21.1
Total	8810		Total	4		Total	0		Total	0		Total	19	

* 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)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Agama	36 (42)	23 (31)	24 (32)	36 (37)	24 (25)
Agona	62 (71)	66 (82)	19 (20)	39 (39)	25 (28)
Ajiobo	3 (3)	1 (1)	4 (4)	2 (2)	6 (6)
Anatum	8 (13)	10 (11)	20 (31)	45 (46)	35 (38)
Ank	- (-)	- (-)	1 (1)	- (-)	- (-)
Berta	- (-)	- (-)	- (-)	- (-)	1 (1)
Binza	51 (67)	60 (66)	100 (134)	84 (89)	91 (96)
Bovis morbificans	- (-)	2 (2)	1 (1)	- (-)	1 (1)
Bradford	- (-)	- (-)	- (-)	- (-)	1 (1)
Braenderup	3 (3)	1 (1)	1 (1)	2 (2)	1 (1)
Brandenburg	4 (4)	4 (4)	1 (1)	16 (18)	20 (23)
Bredeney	55 (60)	6 (6)	15 (17)	18 (18)	3 (3)
Carno	- (-)	- (-)	- (-)	1 (1)	- (-)
Cerro	1 (1)	- (-)	- (-)	- (-)	- (-)
Champaign	2 (2)	- (-)	- (-)	- (-)	- (-)
Choleraesuis	1 (1)	- (-)	- (-)	- (-)	- (-)
Choleraesuis-vk	- (-)	1 (1)	- (-)	- (-)	- (-)
Corvallis	- (-)	- (-)	- (-)	3 (3)	6 (6)
Cubana	- (-)	1 (1)	- (-)	1 (1)	- (-)
Derby	81 (122)	73 (93)	40 (45)	86 (95)	62 (64)
Dublin	684 (914)	441 (559)	809 (1030)	1000 (1207)	804 (819)
Durham	- (-)	2 (2)	- (-)	2 (2)	1 (1)
Ealing	- (-)	1 (1)	- (-)	- (-)	- (-)
Eimsbuettel	- (-)	6 (7)	1 (1)	- (-)	- (-)
Enteritidis	41 (55)	26 (27)	30 (37)	71 (74)	23 (29)
Fischerkietz	17 (21)	2 (3)	1 (1)	- (-)	2 (2)
Give	148 (164)	19 (19)	32 (32)	30 (30)	48 (48)
Goldcoast	20 (29)	10 (12)	21 (24)	20 (22)	11 (11)
Hadar	46 (60)	8 (10)	48 (56)	54 (56)	54 (67)
Hato	- (-)	1 (1)	- (-)	- (-)	- (-)
Havana	1 (1)	3 (3)	4 (6)	18 (18)	10 (10)
Heidelberg	75 (98)	52 (60)	24 (24)	3 (3)	- (-)
Idikan	- (-)	1 (1)	1 (1)	1 (1)	3 (3)
Indiana	26 (34)	34 (41)	81 (115)	167 (176)	164 (170)
Infantis	4 (5)	5 (9)	7 (7)	11 (11)	21 (21)
Kedougou	98 (103)	60 (68)	74 (85)	95 (96)	93 (95)
Kentucky	16 (23)	10 (15)	3 (4)	- (-)	6 (6)
Kiambu	- (-)	- (-)	- (-)	- (-)	1 (1)
Kimuenza	- (-)	- (-)	1 (1)	3 (4)	1 (1)
Kottbus	20 (21)	18 (20)	11 (11)	40 (42)	38 (39)

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

<i>Salmonella</i> Incidents (Isolations)	2000		2001*		2002		2003		2004	
ENTERICA ENTERICA										
Larochelle	21	(24)	2	(2)	3	(3)	1	(1)	1	(1)
Lexington	-	(-)	1	(1)	1	(1)	-	(-)	10	(10)
Lille	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Liverpool	31	(31)	60	(73)	31	(35)	27	(27)	42	(48)
Livingstone	54	(68)	75	(90)	137	(220)	197	(199)	244	(249)
London	2	(2)	1	(1)	5	(5)	3	(3)	9	(10)
Manhattan	2	(3)	-	(-)	-	(-)	2	(2)	-	(-)
Mbandaka	45	(56)	60	(80)	55	(62)	50	(54)	25	(26)
Meleagridis	-	(-)	-	(-)	1	(1)	2	(2)	1	(1)
Menston	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Montevideo	107	(170)	114	(162)	86	(145)	142	(156)	77	(78)
Muenchen	1	(1)	-	(-)	1	(1)	-	(-)	-	(-)
Nagoya	-	(-)	1	(1)	2	(2)	2	(2)	-	(-)
New Brunswick	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Newington	-	(-)	2	(2)	-	(-)	-	(-)	-	(-)
Newport	45	(56)	31	(35)	42	(48)	49	(49)	58	(59)
Ohio	35	(65)	23	(27)	38	(49)	33	(33)	30	(30)
Orion	9	(11)	11	(14)	53	(76)	50	(51)	41	(43)
Oslo	-	(-)	-	(-)	-	(-)	6	(6)	1	(1)
Panama	4	(5)	1	(1)	2	(2)	-	(-)	-	(-)
Paratyphi B var java	1	(1)	-	(-)	-	(-)	2	(3)	-	(-)
Poona	3	(3)	1	(1)	-	(-)	1	(1)	2	(2)
Pullorum	3	(3)	4	(4)	4	(4)	4	(5)	2	(4)
Reading	3	(3)	1	(1)	5	(5)	7	(7)	8	(8)
Rissen	-	(-)	-	(-)	-	(-)	-	(-)	2	(2)
Rubislaw	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Ruiru	1	(2)	-	(-)	-	(-)	-	(-)	-	(-)
Saint Paul	5	(5)	5	(5)	5	(5)	3	(3)	5	(5)
Schwarzengrund	7	(8)	5	(6)	2	(4)	2	(2)	6	(6)
Senftenberg	270	(368)	154	(274)	117	(160)	72	(74)	80	(81)
Stanley	-	(-)	-	(-)	3	(3)	2	(2)	2	(2)
Stourbridge	-	(-)	-	(-)	-	(-)	3	(3)	2	(2)
Taksony	-	(-)	2	(2)	2	(2)	-	(-)	-	(-)
Teddington	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Tees	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Tennessee	-	(-)	1	(1)	4	(4)	7	(7)	2	(2)
Thomasville	-	(-)	1	(1)	-	(-)	-	(-)	-	(-)
Thompson	78	(80)	60	(60)	35	(36)	15	(16)	35	(46)
Typhimurium	614	(814)	400	(463)	369	(450)	380	(436)	311	(377)
Vejlø	-	(-)	-	(-)	4	(8)	4	(4)	8	(8)

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

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Virchow	32 (35)	25 (26)	48 (49)	87 (92)	41 (43)
Wangata	- (-)	- (-)	1 (1)	- (-)	- (-)
Worthington	3 (3)	1 (1)	- (-)	1 (1)	- (-)
ENTERICA DIARIZONAE					
61:k:1,5	47 (49)	10 (10)	22 (22)	9 (9)	1 (1)
61:k:1,5,7	50 (50)	24 (26)	78 (80)	122 (122)	136 (139)
61:k:1,7	- (-)	- (-)	1 (1)	1 (1)	- (-)
61:-:1,5	11 (11)	3 (3)	24 (26)	1 (1)	- (-)
61:-:1,5,7	7 (8)	21 (23)	4 (4)	30 (30)	49 (49)
61:-:1,7	- (-)	- (-)	- (-)	1 (1)	- (-)
ENTERICA HOUTENAE					
43:z4z23	- (-)	1 (1)	- (-)	- (-)	- (-)
UNSPECIFIED					
untypeable	1 (1)	- (-)	- (-)	1 (2)	- (-)
structure only	76 (82)	100 (125)	104 (120)	222 (230)	159 (170)
rough strain	11 (12)	11 (11)	10 (10)	2 (2)	- (1)
untyped	10 (10)	1 (1)	5 (6)	- (-)	- (-)
TOTAL	3093 (3958)	2164 (2725)	2678 (3372)	3399 (3757)	2955 (3129)

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

Fig 2: Incidents of *Salmonella* serotypes in cattle, sheep, pigs & poultry in 2004

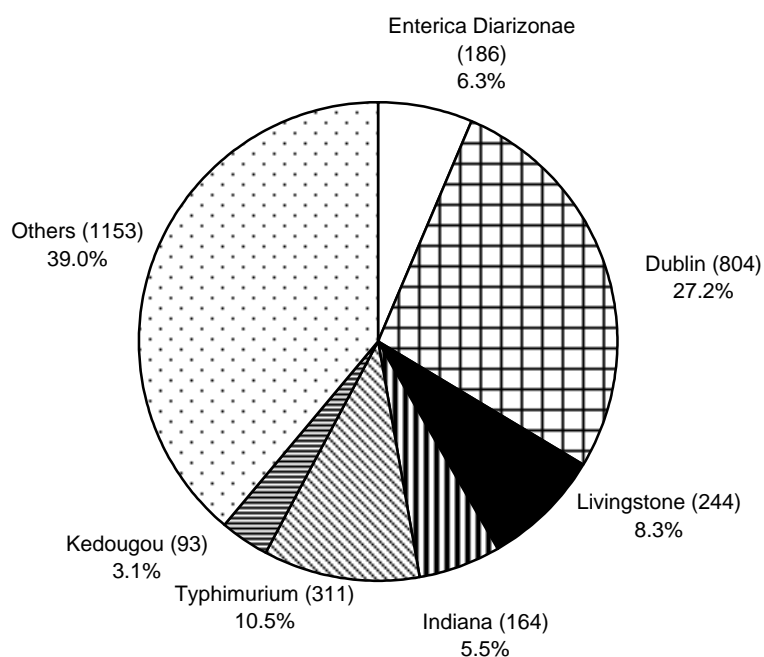
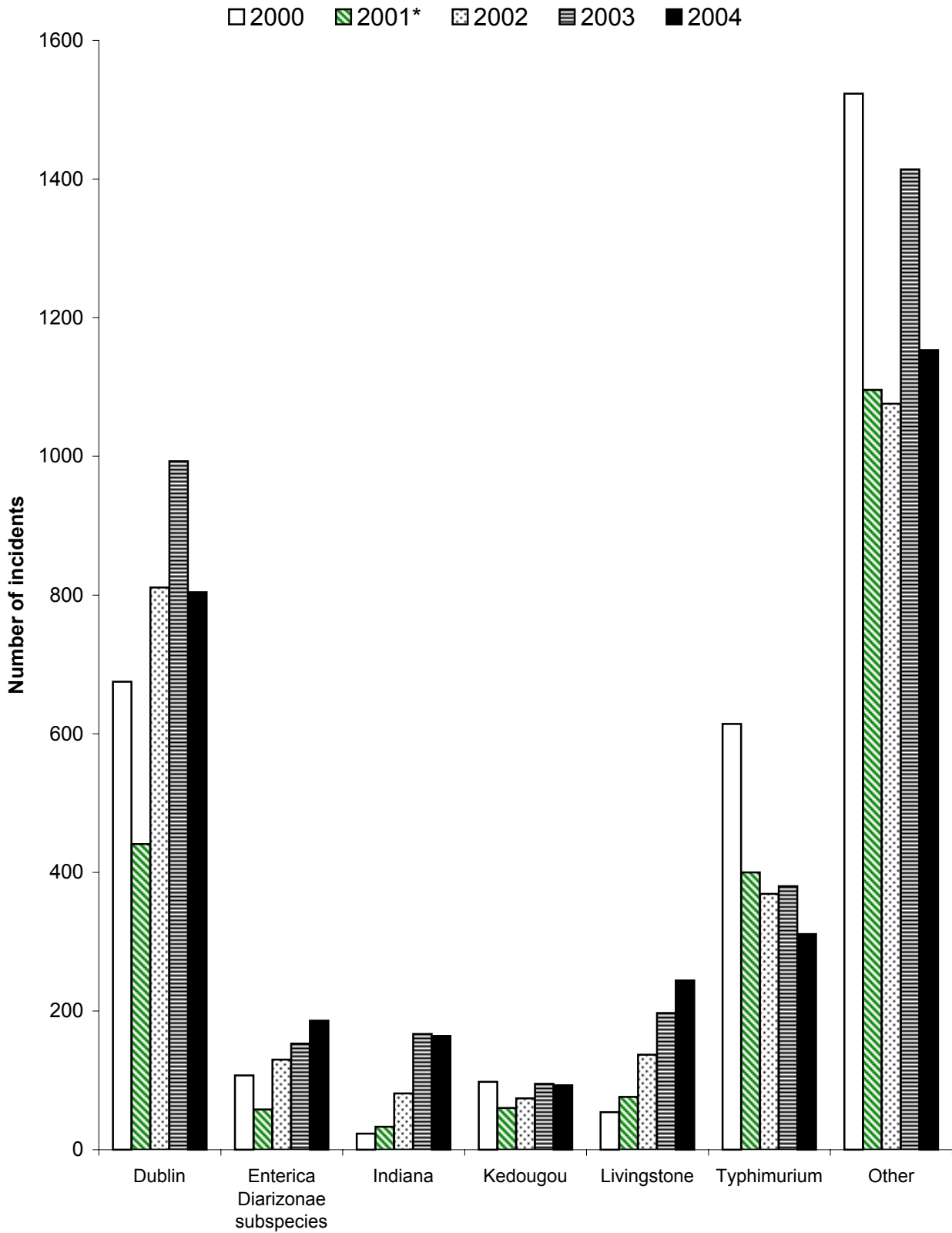


Table 9: Incidents of the top 5 *Salmonella* serotypes in cattle, sheep, pigs and poultry in 2004 as a % of all incidents compared to previous years

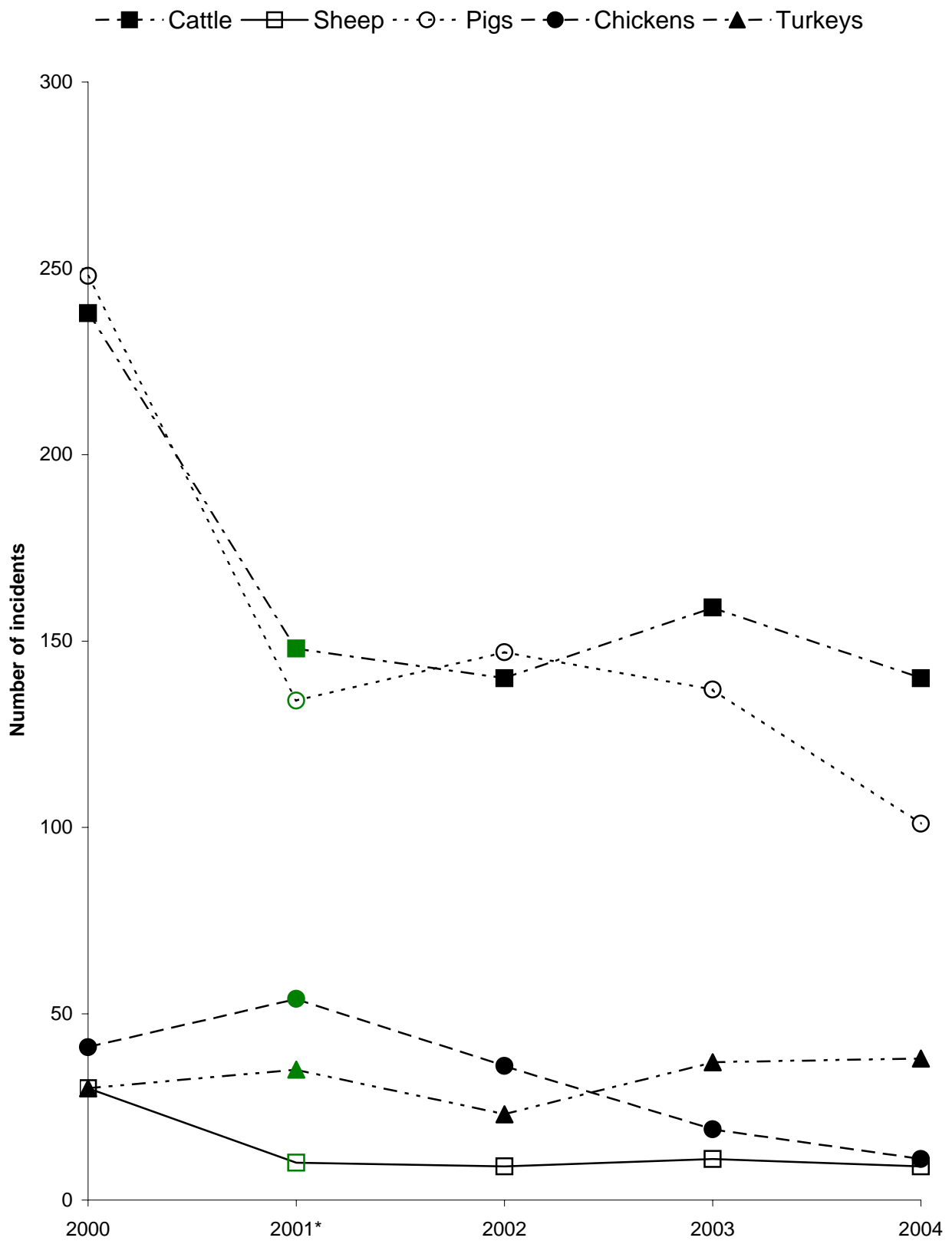
Serotype	2000	2001	2002	2003	2004
S. Dublin %	22.1	20.4	30.2	29.4	27.2
S. Typhimurium %	19.9	18.5	13.8	11.1	10.5
S. Livingstone %	1.7	3.5	5.1	5.8	8.3
S. <i>Enterica Diarizonae</i> subspecies %	3.7	2.7	4.8	4.5	6.3
S. Indiana %	0.8	1.6	3.0	4.9	5.5
Total no. incidents	3093	2164	2678	3399	2955

Fig 3: Incidents of *Salmonella* serotypes in cattle, sheep, pigs & poultry 2000 - 2004



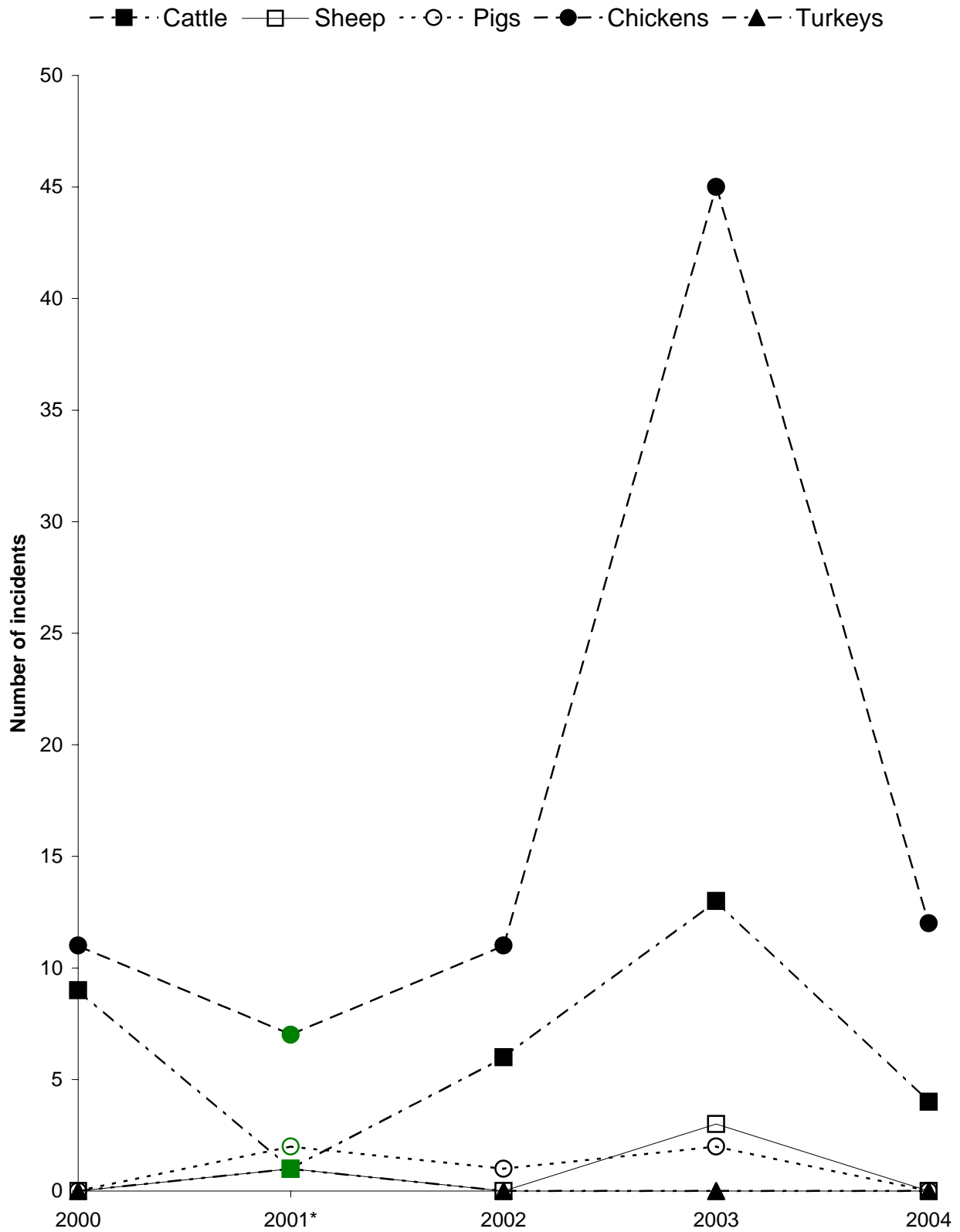
* 2001 data may not be comparable due to uncertain impact of FMD epidemic

Fig 4: Number of incident reports of *Salmonella* Typhimurium in livestock (2000 - 2004)



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

Fig 5: Number of incident reports of *Salmonella* Enteritidis in livestock (2000 - 2004)



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