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 8. 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 Health Protection Scotland (HPS) (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 2006 (Defra 2007, in press).

In recent 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 2006 the total number of *Salmonella* incident reports decreased by 6.25% compared with 2005 and decreased by 25.1% compared with 2004. However, this was not consistent across serovars. Compared with 2005, reports of *S*. Typhimurium increased by 34.4%, reports of *S*. Kedougou increased by 67.6% and there were decreases in the number of reports of *S*. Dublin (17.9%), *S*. Kottbus (26.7%), *S*. Livingstone (54.7%), *S*. Newport (35.4%) and *S*. Senftenberg (32.6); there was therefore a change in the distribution of reports between these serovars. *S*. Dublin was in 2006, for the eighth successive year, the serovar most commonly isolated from livestock and was responsible for one fifth of reports, the same as in 2005. *S*. Typhimurium was again the second most common serovar (19.4%), *S*. Indiana the third (7.2%), *S*. *enterica diarizonae* subspecies the fourth (6.9%) and *S*. Kedougou the fifth (5.3%).

Some serovars of *Salmonella* can infect a wide variety of host groups, for example, *S*. Typhimurium. Others tend to be associated with a particular animal group, for example, *S*. Enteritidis and poultry, *S*. Dublin and cattle and *S. enterica diarizonae* subspecies and sheep. Thus the serovar distribution reflects the group distribution of reports. In 2006, 43.3% of reports were from poultry, 30.5% from cattle, 8.2% from pigs and 8.7% from sheep (see Table 1). There were 44 reports of *Salmonella* from horses in 2006 (the same as in 2005), three reports from goats, one report from deer, and no reports from rabbits.

Changes in the number of incidents have to be treated with caution in view of the inherent biases associated with the data collection.

Tables 8 & 9 and Figure 1 show that in 2006 the total number of incidents of *Salmonella* reported fell by 149 (6.3%) compared with 2005 and by 749 (25.1%) compared with 2004.

The relative frequency of reports of *S*. Enteritidis in 2006 (1.88%) was very similar to 2005 (1.93%); and there were 11 reports of *S*. Enteritidis in chickens, 19 in ducks, four in geese, two in sheep, two in horses, and four in non-statutory species (three in dogs and one in a hedgehog).

The frequency of reports of *S*. Typhimurium (STM) rose to 19.4% of all reports in 2006. The relative frequency of *S*. Typhimurium was reduced in pigs and increased in cattle, sheep, chickens, turkeys and ducks. The frequency of *S*. Typhimurium DT104 reports in cattle increased to 65.2% of all STM reports in 2006 compared with 60.3% in 2005.

The number of incidents of *S.* Dublin reported in cattle decreased by 17.6% in 2006, mostly due to a fall in reports from adult cattle. The proportion of incidents of *S*. Dublin in cattle also decreased in 2006, although this serovar was again the most common reported in cattle (60.5%).

Reports of *S. enterica* subspecies *diarizonae* (mainly from sheep) increased slightly and for the eighth year running *S. enterica* subspecies *diarizonae* 61:k:1,5(7) and variants were most common serovars isolated from sheep (71.4%).

The three most common serovars reported from humans in 2006 were *S*. Enteritidis (55.3% of all reports), *S*. Typhimurium (12.1% of all reports) and *S*. Virchow (3.2% of all reports). By contrast the most common serovars reported from livestock during this period were *S*. Dublin (21.0% of all reports), *S*. Typhimurium (19.4% of reports) and

S. Indiana (7.2% of reports). There were very few reports of *S*. Virchow from livestock, which accounted for 0.6% of all reports in 2006. The most frequently reported definitive types of *S*. Typhimurium in humans during 2006 were DT104 and DT193 (21.6% and 6.0% of all *S*. Typhimurium reports respectively) and the most common phage types of *S*. Enteritidis reported from humans were PT4 and PT1 (27.0% and 19.1% of all *S*. Enteritidis reports respectively). *S*. Typhimurium DT193 is a strain associated in livestock mainly with pigs and to a lesser extent cattle. In livestock, DT104 was the most common phage type of *S*. Typhimurium in both cattle (65.2%) and sheep (70.6%), and U288 was the most common in pigs (48.1%). *S*. Enteritidis PT4 and PT1 are both occasionally reported from livestock, mainly from chickens

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

Serotypes that have been reported in livestock for the first time in 2006 are *Salmonella* Butantan, *S*. Concord, *S*. Eboko and *S*. Riggil (all from cattle) and *S*. Oskarshamn from chickens. Of these five serotypes, all except *S*. Oskarshamn have previously been reported from animal feedstuffs.

Table 5 ranks the most common *Salmonella* serovars isolated from livestock in Great Britain in 2006 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 *Salmonella* Typhimurium and *Salmonella* 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 6.9% in 2006 compared with 2005.

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 2006 again saw a depressed livestock industry.

Diagnostic submissions to the Veterinary Laboratories Agency (VLA) and the Scottish Agricultural College (SAC) have declined in recent years. The total number of diagnostic submissions received in 2006 decreased by 15.4% compared with 2005. 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.

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. The assessment of submission rates in poultry is further complicated by the large proportion of *Salmonella* testing undertaken by private laboratories.

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.

Fig 1: Number of incident reports of *Salmonella* in livestock (2002 - 2006)

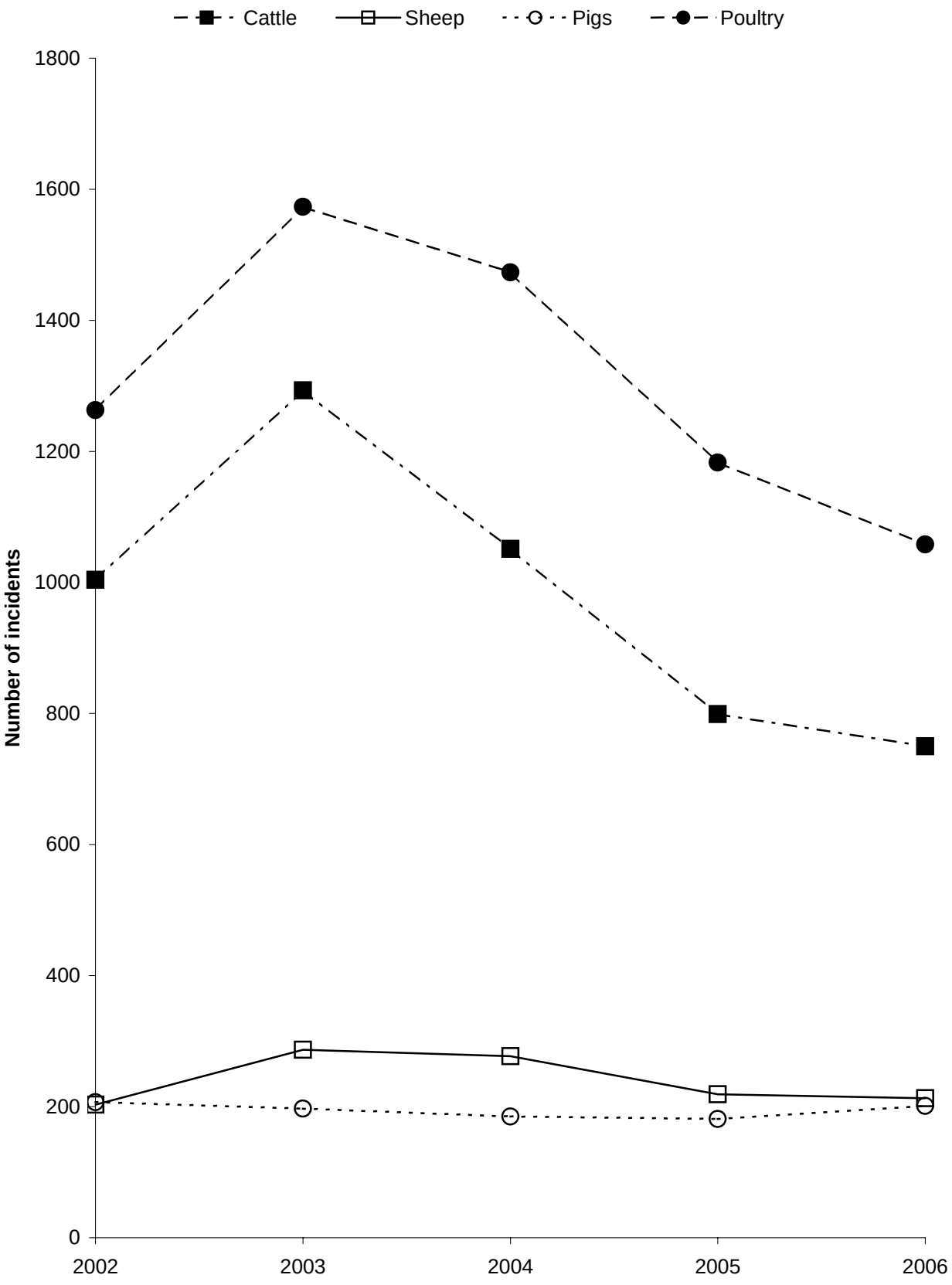

Table 5: Reports of the most common *Salmonella* serotypes in 2006 in livestock and humans in Great Britain

Human cases			Cattle			Sheep			Pigs			Poultry		
Serotype	No. isolations	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%	Serotype	No. incidents	%
Enteritidis	7421	55.3	Dublin	454	60.5	*Enterica diarizonae* subspp	152	71.4	Typhimurium	133	66.2	Indiana	161	15.2
Typhimurium	1623	12.1	Typhimurium	161	21.5	Typhimurium	17	8.0	Derby	28	13.9	Typhimurium	121	11.4
Virchow	423	3.2	Anatum	28	3.7	Dublin	14	6.6	Kedougou	10	5.0	Kedougou	109	10.3
Newport	247	1.8	Montevideo	17	2.3	Montevideo	9	4.2	Reading	7	3.5	Binza	67	6.3
Infantis	163	1.2	Agama	16	2.1	Agama	8	3.8	Goldcoast	5	2.5	Senftenberg	62	5.9
Stanley	160	1.2	Newport	12	1.6							Livingstone	61	5.8
Montevideo	156	1.2										Kottbus	53	5.0
Ajiobo	153	1.1										Ohio	38	3.6
Braenderup	99	0.7										Derby	36	3.4
Kentucky	98	0.7										Enteritidis	34	3.2
												Orion	34	3.2
Other serotypes	2869	21.4	Other serotypes	62	8.3	Other serotypes	13	6.1	Other serotypes	18	9.0	Other serotypes	282	26.7
Total	13412		Total	750		Total	213		Total	201		Total	1058	

* Reports to the Health Protection Agency and Health Protection Scotland, provisional data

Table 6: Reports of the most common *Salmonella* Typhimurium definitive types in 2006 in livestock and humans in Great Britain

Human cases			Cattle			Sheep			Pigs			Poultry		
DT	No. isolations	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%	DT	No. incidents	%
104	350	21.6	104	105	65.2	104	12	70.6	U288	64	48.1	8	36	29.8
193	97	6.0	104b	9	5.6				193	26	19.5	104	34	28.1
8	91	5.6	193	8	5.0				U302	12	9.0	195	27	22.3
120	69	4.3	U302	7	4.3				UNTY	8	6.0	2	5	4.1
104b	58	3.6	UNTY	7	4.3				104	7	5.3	30	5	4.1
135	43	2.6	135	6	3.7							41	3	2.5
1	41	2.5												
U302	40	2.5												
56	39	2.4												
41	35	2.2												
Other DTs	760	46.8	Other DTs	19	11.8	Other DTs	5	29.4	Other DTs	16	12.0	Other DTs	11	9.1
Total	1623		Total	161		Total	17		Total	133		Total	121	

* Reports to Health Protection Agency and Health Protection Scotland, provisional data

Table 7: Reports of the most common *Salmonella* Enteritidis phage types in 2006 in livestock and humans in Great Britain

Human cases*			Cattle			Sheep			Pigs			Poultry		
PT	No. isolations	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%	PT	No. incidents	%
4	2004	27.0				11	1	50.0				9b	9	26.5
1	1414	19.1				35	1	50.0				1	7	20.6
8	1061	14.3										6a	5	14.7
21	593	8.0										6	4	11.8
14b	507	6.8										UNTY	3	8.8
6	233	3.1										4	2	5.9
6a	208	2.8										3	1	2.9
13a	113	1.5										7	1	2.9
56	88	1.2										14b	1	2.9
11	76	1.0										28	1	2.9
Other PTs	1124	15.1	Other PTs	0		Other PTs	0		Other PTs	0		Other PTs	0	
Total	7421		Total	0		Total	2		Total	0		Total	34	

* Reports to Health Protection Agency and Health Protection Scotland, provisional data

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

Salmonella Incidents (Isolations)	2002		2003		2004		2005		2006	
ENTERICA ENTERICA										
Agama	24	(34)	31	(37)	25	(25)	24	(27)	28	(36)
Agona	19	(20)	35	(39)	27	(28)	23	(25)	16	(23)
Ajiobo	4	(4)	1	(2)	6	(6)	1	(1)	1	(1)
Anatum	20	(31)	41	(46)	35	(38)	34	(43)	32	(39)
Ank	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Berta	-	(-)	-	(-)	1	(1)	-	(-)	1	(2)
Binza	100	(134)	77	(89)	91	(96)	48	(60)	67	(82)
Bovis morbificans	1	(1)	-	(-)	1	(1)	2	(4)	5	(8)
Bradford	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
Braenderup	1	(1)	2	(2)	1	(1)	-	(-)	1	(1)
Brandenburg	1	(1)	11	(18)	19	(23)	-	(-)	-	(-)
Bredeney	15	(17)	15	(18)	3	(3)	1	(1)	4	(4)
Butantan	-	(-)	-	(-)	-	(-)	-	(-)	4	(7)
Carno	-	(-)	1	(1)	-	(-)	1	(1)	-	(-)
Cerro	-	(-)	-	(-)	-	(-)	-	(-)	3	(6)
Choleraesuis	-	(-)	-	(-)	1	(1)	1	(1)	-	(-)
Coeln	-	(-)	-	(-)	-	(-)	1	(1)	2	(2)
Concord	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Corvallis	-	(-)	3	(3)	6	(6)	1	(1)	-	(-)
Cubana	-	(-)	1	(1)	-	(-)	1	(1)	-	(-)
Derby	40	(45)	71	(95)	62	(64)	72	(93)	68	(93)
Dublin	809	(1030)	1058	(1213)	785	(821)	571	(693)	469	(559)
Duesseldorf	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Durham	-	(-)	2	(2)	1	(1)	1	(1)	2	(2)
Eboko	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Eimsbuettel	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Enteritidis	30	(37)	66	(75)	24	(29)	46	(106)	42	(60)
Fischerkietz	1	(1)	-	(-)	2	(2)	-	(-)	-	(-)
Gallinarum	-	(-)	-	(-)	-	(-)	5	(9)	5	(14)
Give	32	(32)	29	(31)	47	(47)	24	(26)	16	(17)
Gloucester	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Goldcoast	21	(24)	19	(22)	10	(11)	9	(11)	9	(9)
Hadar	48	(56)	52	(56)	60	(66)	25	(27)	28	(31)
Havana	4	(6)	16	(18)	10	(10)	10	(10)	15	(17)
Heidelberg	24	(24)	2	(3)	-	(-)	-	(-)	-	(-)
Idikan	1	(1)	1	(1)	3	(3)	11	(11)	2	(2)
Indiana	81	(115)	160	(176)	163	(170)	171	(219)	161	(223)
Infantis	7	(7)	11	(11)	21	(21)	7	(8)	5	(8)
Jangwani	-	(-)	-	(-)	-	(-)	2	(4)	-	(-)

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

Salmonella Incidents (Isolations)	2002		2003		2004		2005		2006	
ENTERICA ENTERICA										
Kedougou	74	(85)	92	(96)	94	(95)	71	(89)	119	(138)
Kentucky	3	(4)	-	(-)	6	(6)	2	(2)	4	(4)
Kiambu	-	(-)	-	(-)	1	(1)	-	(-)	-	(-)
Kimuenza	1	(1)	2	(4)	1	(1)	-	(-)	2	(2)
Kokomlemle	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Kottbus	11	(11)	37	(42)	38	(39)	75	(91)	55	(73)
Larochelle	3	(3)	1	(1)	1	(1)	1	(1)	-	(-)
Lexington	1	(1)	-	(-)	10	(10)	3	(3)	-	(-)
Liverpool	31	(35)	27	(27)	47	(48)	16	(17)	2	(3)
Livingstone	137	(220)	185	(199)	243	(248)	137	(183)	62	(78)
London	5	(5)	3	(3)	8	(10)	4	(5)	4	(7)
Manhattan	-	(-)	2	(2)	-	(-)	-	(-)	-	(-)
Mbandaka	55	(62)	50	(54)	25	(26)	20	(28)	35	(44)
Meleagridis	1	(1)	2	(2)	1	(1)	3	(3)	-	(-)
Menston	-	(-)	1	(1)	-	(-)	2	(2)	-	(-)
Montevideo	86	(145)	147	(156)	60	(74)	49	(66)	42	(59)
Muenchen	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Nagoya	2	(2)	2	(2)	-	(-)	-	(-)	1	(1)
Newport	42	(48)	43	(48)	57	(59)	48	(52)	31	(38)
Ohio	38	(49)	32	(32)	31	(31)	24	(27)	41	(45)
Orion	53	(76)	48	(51)	42	(43)	43	(48)	34	(54)
Oskarshamn	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Oslo	-	(-)	6	(6)	1	(1)	1	(1)	-	(-)
Panama	2	(2)	-	(-)	-	(-)	-	(-)	1	(1)
Paratyphi B	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Paratyphi B var java	-	(-)	3	(3)	-	(-)	-	(-)	-	(-)
Poona	-	(-)	1	(1)	2	(2)	1	(1)	-	(-)
Pullorum	4	(4)	5	(5)	3	(4)	-	(1)	-	(1)
Reading	5	(5)	7	(7)	8	(8)	13	(13)	10	(10)
Riggil	-	(-)	-	(-)	-	(-)	-	(-)	1	(1)
Rissen	-	(-)	-	(-)	2	(2)	5	(5)	1	(1)
Saint Paul	5	(5)	3	(3)	5	(5)	25	(28)	11	(14)
Schwarzengrund	2	(4)	2	(2)	6	(6)	1	(1)	1	(1)
Senftenberg	117	(160)	68	(74)	79	(80)	95	(140)	64	(86)
Stanley	3	(3)	-	(1)	2	(2)	-	(-)	1	(1)
Stourbridge	-	(-)	3	(3)	2	(2)	3	(3)	5	(5)
Sundsvall	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Taksony	2	(2)	-	(-)	-	(-)	-	(-)	3	(3)
Tennessee	4	(4)	7	(7)	2	(2)	2	(2)	-	(-)
Thompson	35	(36)	14	(16)	39	(40)	29	(34)	14	(16)
Typhimurium	369	(450)	362	(433)	354	(375)	323	(447)	434	(541)

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

Salmonella Incidents (Isolations)	2002		2003		2004		2005		2006	
ENTERICA ENTERICA										
Uganda	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
Vejle	4	(8)	4	(4)	8	(8)	-	(-)	-	(-)
Virchow	48	(49)	86	(92)	42	(43)	18	(19)	14	(19)
Wangata	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
Worthington	-	(-)	1	(1)	-	(-)	-	(-)	1	(1)
Yoruba	-	(-)	1	(1)	1	(1)	2	(2)	1	(1)
ENTERICA DIARIZONAE										
61:k:1,5	22	(22)	9	(9)	1	(1)	1	(1)	2	(2)
61:k:1,5,7	78	(80)	120	(122)	136	(139)	99	(105)	86	(88)
61:k:1,7	1	(1)	-	(-)	-	(-)	4	(4)	-	(-)
61:-:1,5	24	(26)	1	(2)	-	(-)	-	(-)	5	(5)
61:-:1,5,7	4	(4)	30	(30)	49	(49)	48	(48)	57	(58)
61:-:1,7	-	(-)	1	(1)	-	(-)	-	(-)	4	(4)
UNSPECIFIED										
untypeable	-	(-)	-	(2)	-	(-)	-	(-)	-	(1)
structure only	104	(120)	211	(228)	161	(166)	97	(184)	78	(130)
rough strain	10	(10)	-	(3)	1	(2)	8	(8)	17	(18)
untyped	5	(6)	-	(-)	-	(-)	-	(-)	-	(1)
TOTAL	2678	(3372)	3341	(3753)	2981	(3113)	2381	(3068)	2232	(2804)

Fig 2: Incidents of *Salmonella* serotypes in cattle, sheep, pigs & poultry in 2006

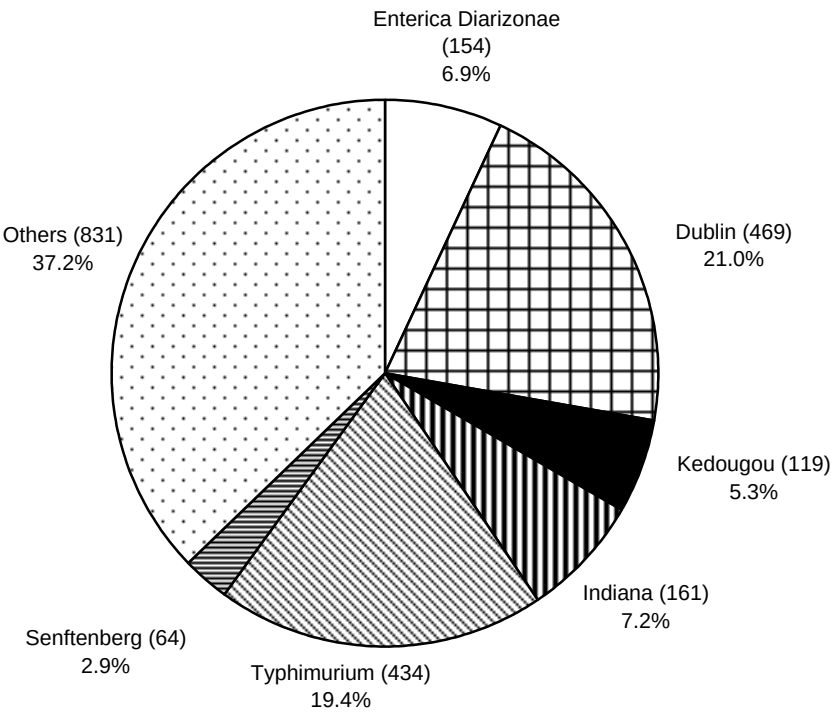

Table 9: Incidents of the top 5 *Salmonella* serotypes in cattle, sheep, pigs and poultry in 2006 as a % of all incidents compared to previous years

Serotype	**2002**	**2003**	**2004**	**2005**	**2006**
S.Dublin %	30.2	31.7	26.3	24.0	21.0
S. Typhimurium %	13.8	10.8	11.9	13.6	19.4
S. Indiana %	3.0	4.8	5.5	7.2	7.2
S. *Enterica Diarizonae* subspecies %	4.8	4.8	6.2	6.4	6.9
S. Kedougou %	2.8	2.8	3.2	3.0	5.3
Total no. incidents	2678	3341	2981	2381	2232

Fig 3: Incidents of S*almonella* serotypes in cattle, sheep, pigs & poultry 2002 - 2006

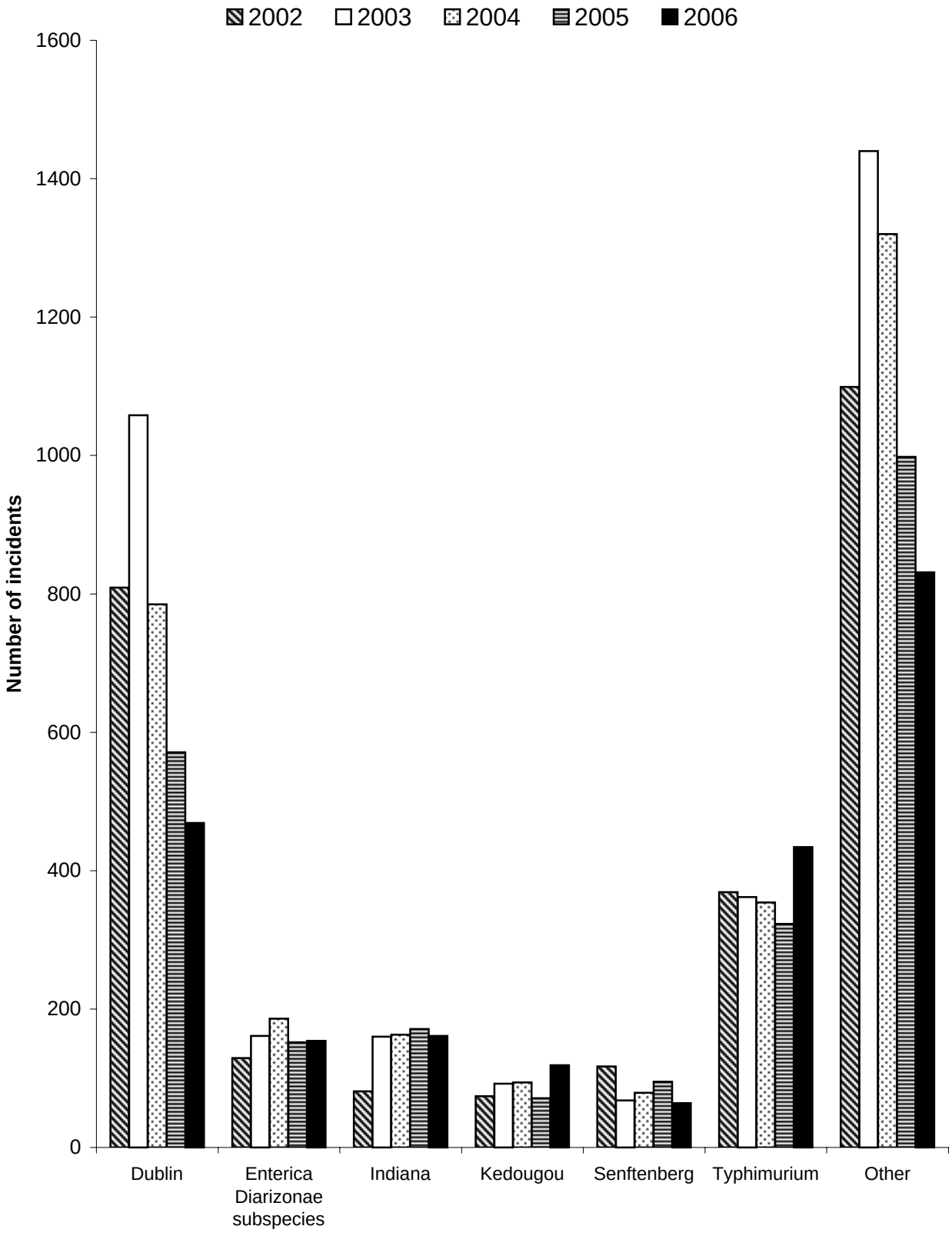

Fig 4: Number of incident reports of *Salmonella* Typhimurium in livestock (2002 - 2006)

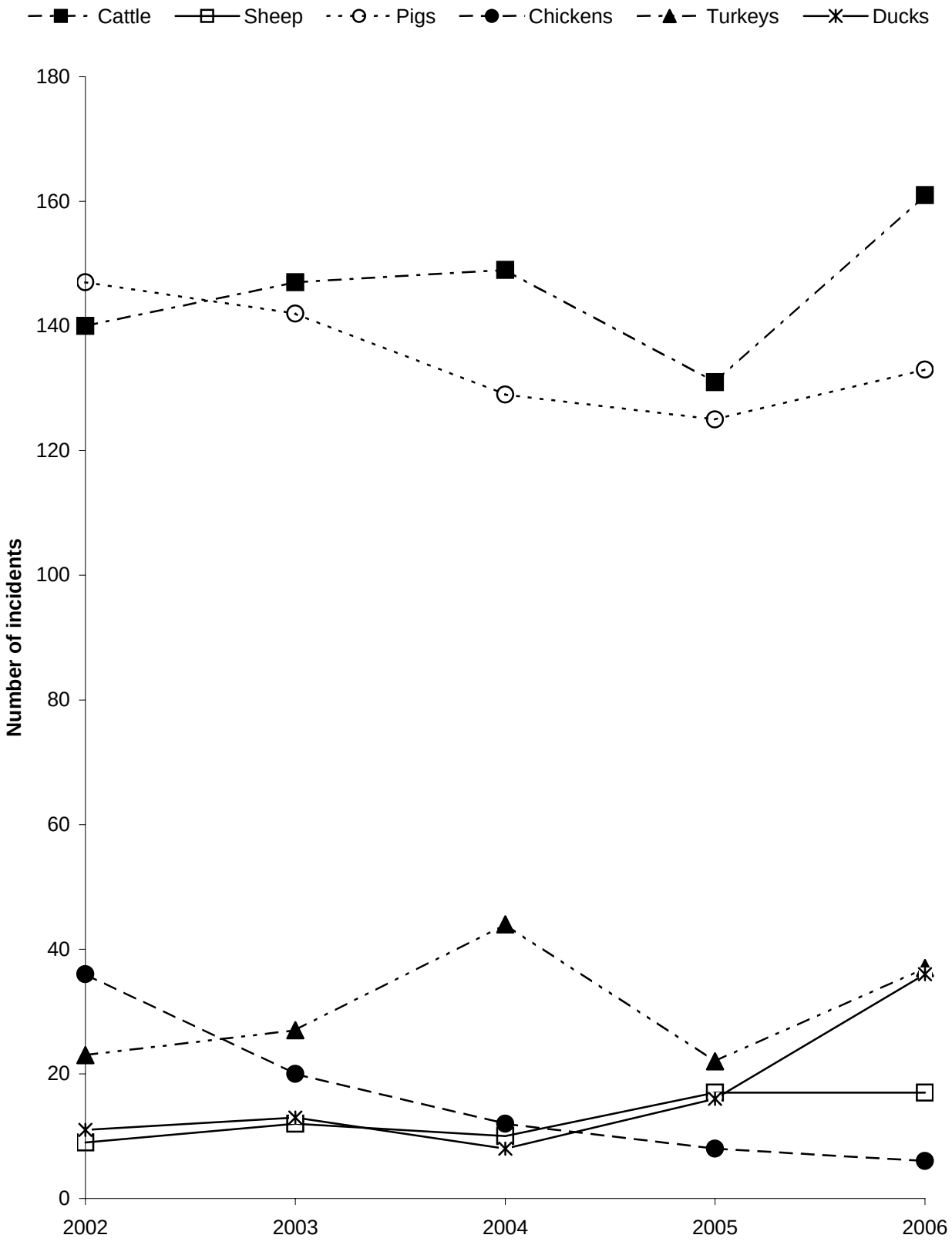

Fig 5: Number of incident reports of *Salmonella* Enteritidis in livestock (2002 - 2006)

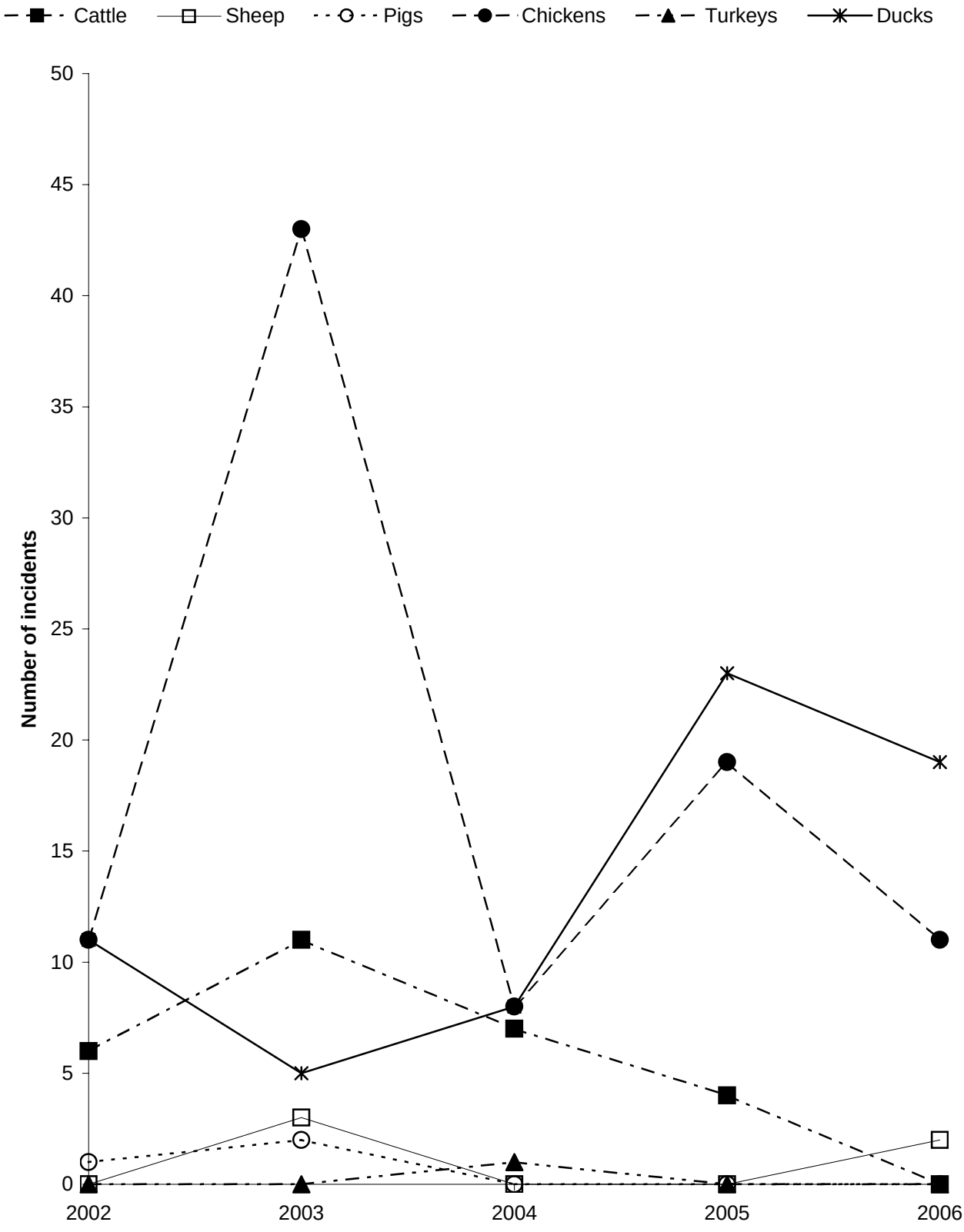

Fig 6: Number of incident reports of *Salmonella* Hadar in livestock (2002 - 2006)

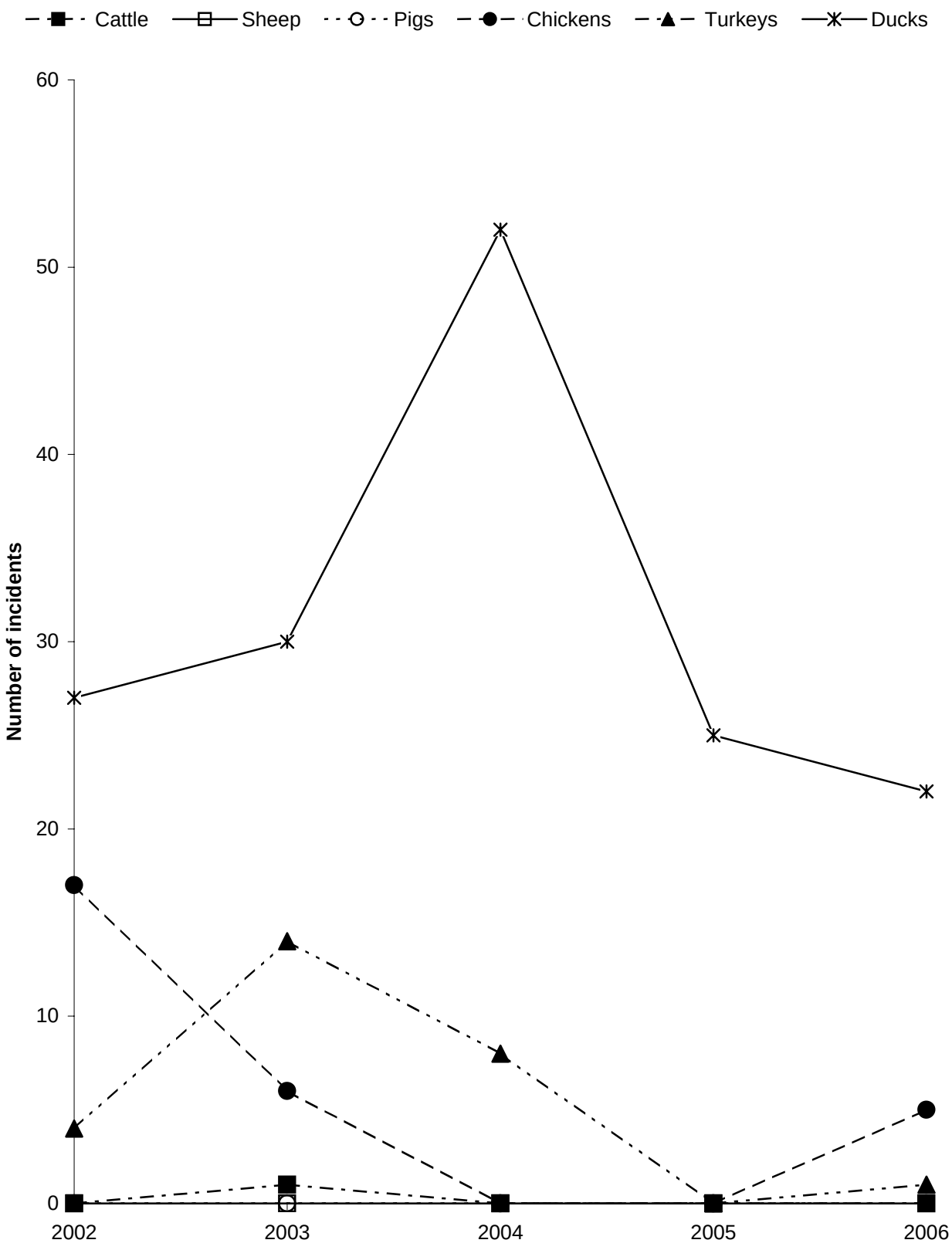

Fig 7: Number of incident reports of *Salmonella* Infantis in livestock (2002 - 2006)

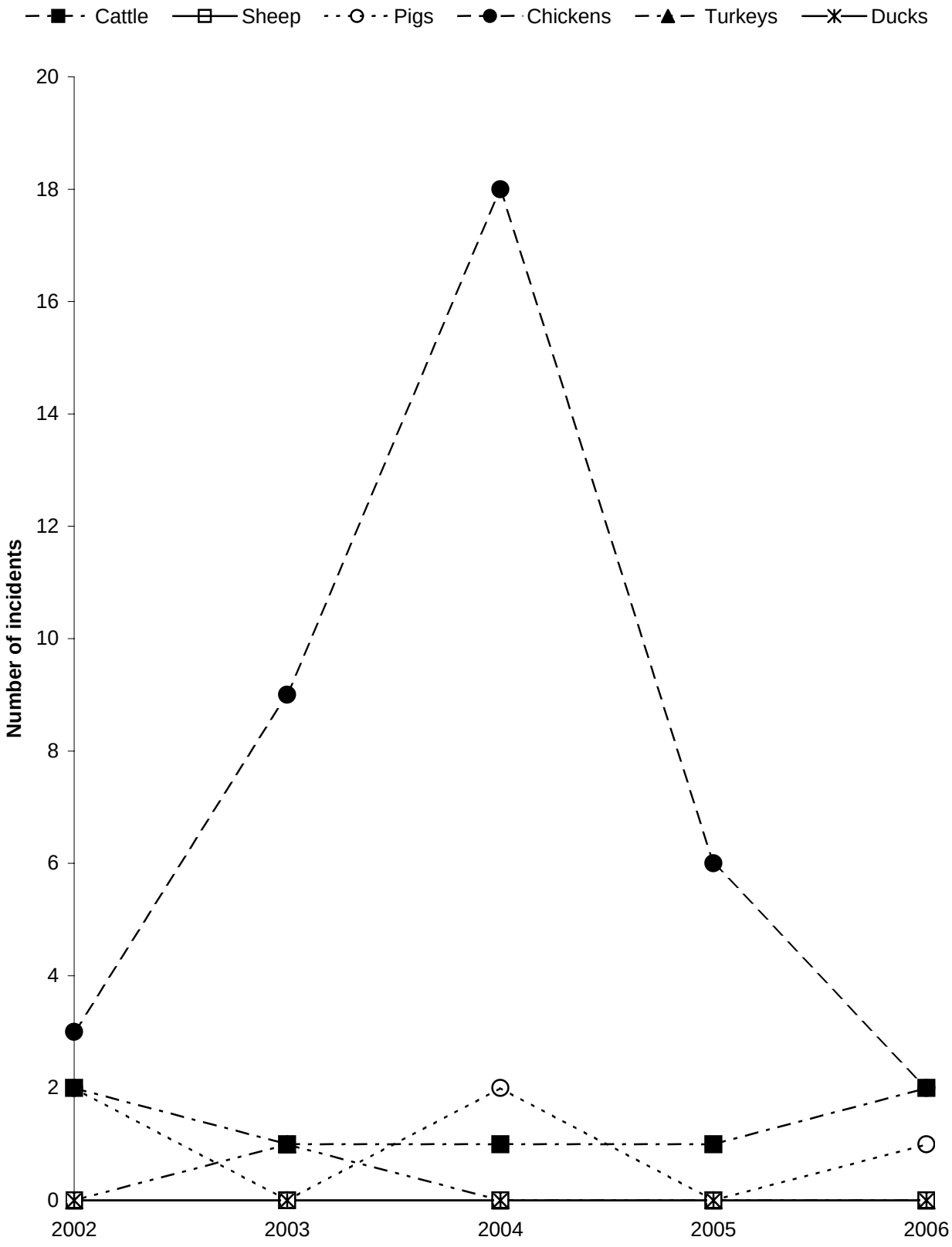

Fig 8: Number of incident reports of *Salmonella* Virchow in livestock (2002 - 2006)