

# Chapter 2.1

## REPORTS OF *SALMONELLA* IN CATTLE

Results are given for adult cattle (10 months of age and older), calves (less than 10 months of age) and cattle of all ages (adult cattle, calves and cattle of unknown age). All isolations are recorded by the age of the individual animal. If an incident involves both adult cattle and calves then the age of the index case is used to classify the incident. For example, an incident affecting calves and adults in which the first case was reported in a calf would be reported as a calf-associated incident, but all isolations would be recorded separately for calves and adult cattle. It is therefore possible that the number of incidents of a particular serovar in one age class may be zero, although several isolations are listed.

There were 8.83 million cattle in Great Britain in 2003, 2% more than in 2002 and 1% less than in 2001. Over half a million adult cattle were slaughtered during the FMD epidemic in 2001. 605,816 cattle were slaughtered in the Over Thirty Months Scheme (OTMS) of the Government's control programme for Bovine Spongiform Encephalopathy (BSE) in the period up to the end of 2003. There have been some changes in the cattle industry with fewer larger farms staying in business in recent years and in some areas more male calves are being kept alive and reared either on their farm of origin or other farms than in recent years. Larger farms with increased numbers of young calves could potentially increase the risk of *Salmonella* isolations. Additional changes post-FMD include increased requirements to clean and disinfect vehicles and livestock movement restrictions, both of which would be expected to have reduced *Salmonella* transmission between premises in recent years, if sustained.

Although there has been a general decrease in the number of diagnostic submissions from cattle reported to the VIDA database in recent years, this number increased in 2003 to a number (45,496) similar to those seen prior to the FMD epidemic (46,868 in 1999; 43,714 in 2000). In 2001 there were fewer diagnostic submissions (31,280) due to the epidemic of FMD (see Introduction). Many farms that were de-populated during the FMD epidemic have been re-stocked and in some cases clinical disease including salmonellosis was reported subsequently. Additional changes post-FMD include increased awareness of the requirements to clean and disinfect vehicles, and additional livestock movement restrictions etc. *Salmonella* data for 2001 are included in italics in the tables because it is not possible to evaluate temporal trends using the 2001 data because of the uncertain impact of FMD control measures.

There is no routine *Salmonella* monitoring of cattle in Great Britain, therefore the majority of isolates come from cattle with clinical disease. The

number of reports is dependent on the total cattle population and number of diagnostic submissions to government veterinary laboratories, both of which have decreased in recent years. As in previous years, the majority (93%) of *Salmonella* incidents (n = 1087) reported in cattle were from samples taken for clinical diagnostic purposes (see Table 1, Chapter 1) and came from cattle on farms.

There were 17% more *Salmonella* incidents in cattle reported in 2003 (1172) than in 2002 (1004). However, there was a 26% increase in the number of cattle submissions from which a diagnosis of *Salmonella* could have been made (from 8180 in 2002 to 10291 in 2003). This may be partly related to increased submission numbers, but is possibly also due to the differences in the way that incidents are allocated by the new computer system (see Chapter 1). Some serovars were reported in cattle in 2003 for the first time in the last five years including *S. Kimuenza*, *S. Oslo*, *S. Stanley*, *S. Stourbridge* and *S. Paratyphi B dT<sup>+</sup>* (var Java). There were a further three incidents of *S. Vejle* infection affecting adult cattle (all in the first quarter), reported for the first time in cattle in 2002. Of the 1172 *Salmonella* incidents in cattle, 41% were in adult cattle, 36.5% in calves and 22.5% in cattle of unknown age. For the fifth year, *S. Dublin* was the most common (79% of incidents) serovar reported in cattle and was the second most common *Salmonella* reported in sheep (see Chapter 2.2).

### ***Salmonella* Dublin**

For the fifth consecutive year, *S. Dublin* was the most common serovar in adult cattle (74% of incidents; Figure 8) and calves (85% of incidents; Figure 10). The relative proportion of *S. Dublin* in adult cattle decreased slightly (from 76 to 74%), as did the relative proportion of *S. Typhimurium* (from 14 to 13%) in 2003 compared to 2002 (Table 12). In contrast, although *S. Typhimurium* reports decreased in calves (from 12% to 8%), the relative proportion of incidents due to *S. Dublin* increased from 81 to 85% (Table 14). There appears to be regional differences in reports, with the majority of *S. Dublin* incidents being reported in Wales and North West England with a few reports from South West England. There continues to be a seasonal increase in the number of incidents during September to October (see Figure 6). *Salmonella* Dublin infection is associated with sporadic cases as well as outbreaks of disease, including enteric or reproductive disease in adult cattle and pneumonia or septicaemia in calves. Nervous signs have been recorded in calves. *S. Dublin* was the second most common infectious cause of bovine fetopathy in GB (11% of diagnosed submissions; VIDA 2003).

## ***Salmonella* Typhimurium**

There is a continuing decline in the number of reports of *S. Typhimurium* in cattle (Table 10). The proportion of *Salmonella* incidents due to this serovar, which is steadily declining, is similar to that in 2002 in adult cattle (13%) but has declined further in calves to 9% (Tables 12 and 14). Several definitive types (DT166, DT169, U288 and U311) were reported in 2003 for the first time in the last five years (Table 15). The DT U288 strain, showing multiple antibiotic resistance, was isolated from the faeces of two-week old dairy calves with diarrhoea. A multiple resistant DT104 was isolated from an incident in which 7 cows and 10 calves died. DT104 remains the most common definitive type (59% of incidents, including DT104b), and is usually found in dairy cattle. Forty-one per cent of incidents were due to non-DT 104 phage types. One incident of *S. Typhimurium* in dairy calves was linked with contamination of feedstores with cat faeces.

## **Other serovars**

*Salmonella* Enteritidis, *S. Hadar*, *S. Thompson* and *S. Virchow* are phage typed routinely. There were 11 reported incidents of *S. Enteritidis* (Table 18). These comprised one incident each of PT 1, 7,8 and 13a in adult cattle, two incidents of PT13a and one of 6a in calves, and two incidents of PT13a and one each of PT4 and PT11 in cattle of unknown ages. All these phage types of *S. Enteritidis* have been reported in cattle in the last five years except PTs 7 and 8 which were last reported in cattle in 1998. There was one incident of *S. Hadar* PT9, the first since 1997 (Table 21), one incident of *S. Thompson* PT3, the first in the last 10 years (Table 23) and no incidents of *S. Virchow* (Table 23). There was a continued increase in the number of *S. Anatum* incidents, particularly in adult cattle (4.4% incidents; Table 12). This serovar was isolated from cases of sporadic peri-parturient dysentery in four dairy herds with no direct links, but in an area noted for its large population of waterfowl.

*S. Kimuenza* (since 1997), *S. Oslo* (since 1996), *S. Stanley* (since 1998), *S. Stourbridge* (since 1998) and *S. Paratyphi B dT<sup>+</sup>* (var Java) (since 1996) were reported in cattle (adult and other ages) for the first time in recent years. *Salmonella* Kottbus had never been isolated from cattle during routine surveillance until 2002, and one further incident was reported in 2003. *Salmonella* Vejle had never been reported from cattle until 2002, and was also responsible for three incidents in 2003. This serovar was last reported in 1990 from chickens and has been seen infrequently in a variety of livestock species and human beings in different countries including Germany, Senegal and Israel. The three incidents of *S. Vejle* originated in the same dairy/dealer enterprise and were associated with clinical disease and mortality in adult cattle, particularly peri-parturient cattle.

*Salmonella* Agama was reported in 13 incidents in cattle, in one case linked to *S. Agama* infection in a badger.

There were 6 incidents of *Salmonella* Newport in cattle, representing 1% of incidents in adult cattle, a slight decrease from 2002. There were no incidents of *S. Newport* in calves in 2003. None of the isolates were resistant to eight or more antimicrobials which is typical of multiple drug resistant *Salmonella* Newport (MDRSN). This latter strain has not yet been reported in GB, but is causing concern in the USA because of its effect in livestock, particularly cattle, and its public health importance (Rankin and others 2002). MDRSN has reduced sensitivity to ceftriaxone, in addition to resistance to at least 8 antimicrobials. In affected dairy herds in the USA, adult cows are reported to have a watery diarrhoea and rapid drop in milk production and clinical signs are often present around calving time. Morbidity and mortality has also been seen in calves on some farms. Like other *Salmonellae*, asymptomatic carriage of the organism occurs ([http://www.aphis.usda.gov/vs/ceah/cahm/Food\\_Safety/foodsfs.htm](http://www.aphis.usda.gov/vs/ceah/cahm/Food_Safety/foodsfs.htm)). The VLA, in collaboration with other organisations, has established case definitions and protocols for fast-tracking the identification and reporting of the organism. In addition, new sampling protocols and epidemiological questionnaires have been developed to be used by the Nominated Officers investigating incidents associated with MDRSN.

An outbreak of salmonellosis in calves associated with a multiple antibiotic resistant strain of *Salmonella* Paratyphi B variant Java (*S. Java*) occurred in October 2003 (Evans and others, submitted 2004). In this incident, multi-resistant *S. Java* was isolated from a group of scouring calves on a calf unit in South West England. Of a group of 300 calves, 8 to 10 one-week old calves were clinically affected with a dark scour, and 5 or 6 of them were reported to have died. An isolate of *S. Java* PT3b var. 2 was obtained, which was resistant to ampicillin, chloramphenicol, streptomycin, sulphonamides, tetracycline, trimethoprim and cefoperazone (ACSSuTTmCfp). This is the first report of *S. Java* with this resistance pattern in Great Britain, and *S. Java* was last isolated from cattle in this country in 1996. There has been a dramatic increase in multi-resistant *S. Java* isolations from poultry in some Member States, and it has become widespread and difficult to control. The HPA reports 100-200 isolates of *S. Java* per year in human beings in Great Britain. Further investigations (carried out in early 2004) included a longitudinal study on the index premises and visits to farms linked to it by animal movements.

**Table 10: *Salmonella* in cattle on all premises (adults, calves & age unknown)**

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Agama	20	( 26)	20	( 25)	13	( 17)	13	( 19)	13	( 16)
Agona	6	( 8)	5	( 5)	4	( 7)	4	( 4)	4	( 4)
Ajiobo	-	( -)	1	( 1)	-	( -)	2	( 2)	1	( 1)
Anatum	6	( 9)	3	( 5)	3	( 4)	15	( 26)	31	( 40)
Ank	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Bovis morbificans	3	( 3)	-	( -)	1	( 1)	-	( -)	-	( -)
Binza	1	( 1)	2	( 2)	-	( -)	-	( -)	-	( -)
Braenderup	1	( 2)	1	( 1)	1	( 1)	-	( -)	-	( -)
Brandenburg	6	( 8)	4	( 4)	1	( 1)	-	( -)	-	( -)
Bredeney	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Derby	2	( 2)	-	( -)	2	( 3)	-	( -)	2	( 2)
Dublin	473	( 641)	671	( 899)	421	( 539)	768	( 985)	924	( 1161)
Durham	1	( 2)	-	( -)	1	( 1)	-	( -)	1	( 1)
Enteritidis	8	( 11)	9	( 9)	1	( 1)	6	( 6)	11	( 14)
Give	2	( 3)	4	( 4)	1	( 1)	1	( 1)	-	( -)
Goerlitz	-	( -)	-	( -)	-	( -)	-	( -)	-	( -)
Goldcoast	7	( 11)	11	( 13)	4	( 4)	3	( 5)	6	( 8)
Hadar	1	( 1)	-	( -)	-	( -)	-	( -)	1	( 1)
Havana	-	( -)	-	( -)	1	( 1)	-	( -)	1	( 1)
Heidelberg	2	( 2)	2	( 2)	1	( 2)	1	( 1)	-	( -)
Indiana	-	( -)	-	( -)	2	( 2)	1	( 1)	-	( -)
Infantis	1	( 1)	2	( 3)	-	( 2)	2	( 2)	1	( 1)
Kedougou	2	( 2)	1	( 1)	-	( -)	-	( -)	5	( 12)
Kentucky	1	( 1)	3	( 3)	-	( -)	1	( 1)	-	( -)
Kimuenza	-	( -)	-	( -)	-	( -)	-	( -)	2	( 4)
Kottbus	-	( -)	-	( -)	-	( -)	1	( 1)	1	( 1)
Livingstone	-	( -)	2	( 2)	-	( -)	-	( -)	( -)	( -)
Mbandaka	6	( 7)	-	( 3)	-	( -)	2	( 2)	( -)	( -)
Meleagridis	1	( 1)	-	( -)	-	( -)	-	( -)	( -)	( -)
Montevideo	1	( 1)	4	( 8)	3	( 4)	3	( 3)	6	( 7)
Muenster	1	( 1)	-	( -)	-	( -)	-	( -)	( -)	( -)
Nagoya	-	( -)	-	( -)	1	( 1)	2	( 2)	1	( 1)
Newington	3	( 4)	-	( -)	1	( 1)	-	( -)	( -)	( -)
Newport	7	( 9)	8	( 11)	7	( 9)	11	( 15)	6	( 7)
Orion	-	( -)	1	( 3)	-	( -)	-	( -)	-	( -)
Oslo	-	( -)	-	( -)	-	( -)	-	( -)	3	( 5)

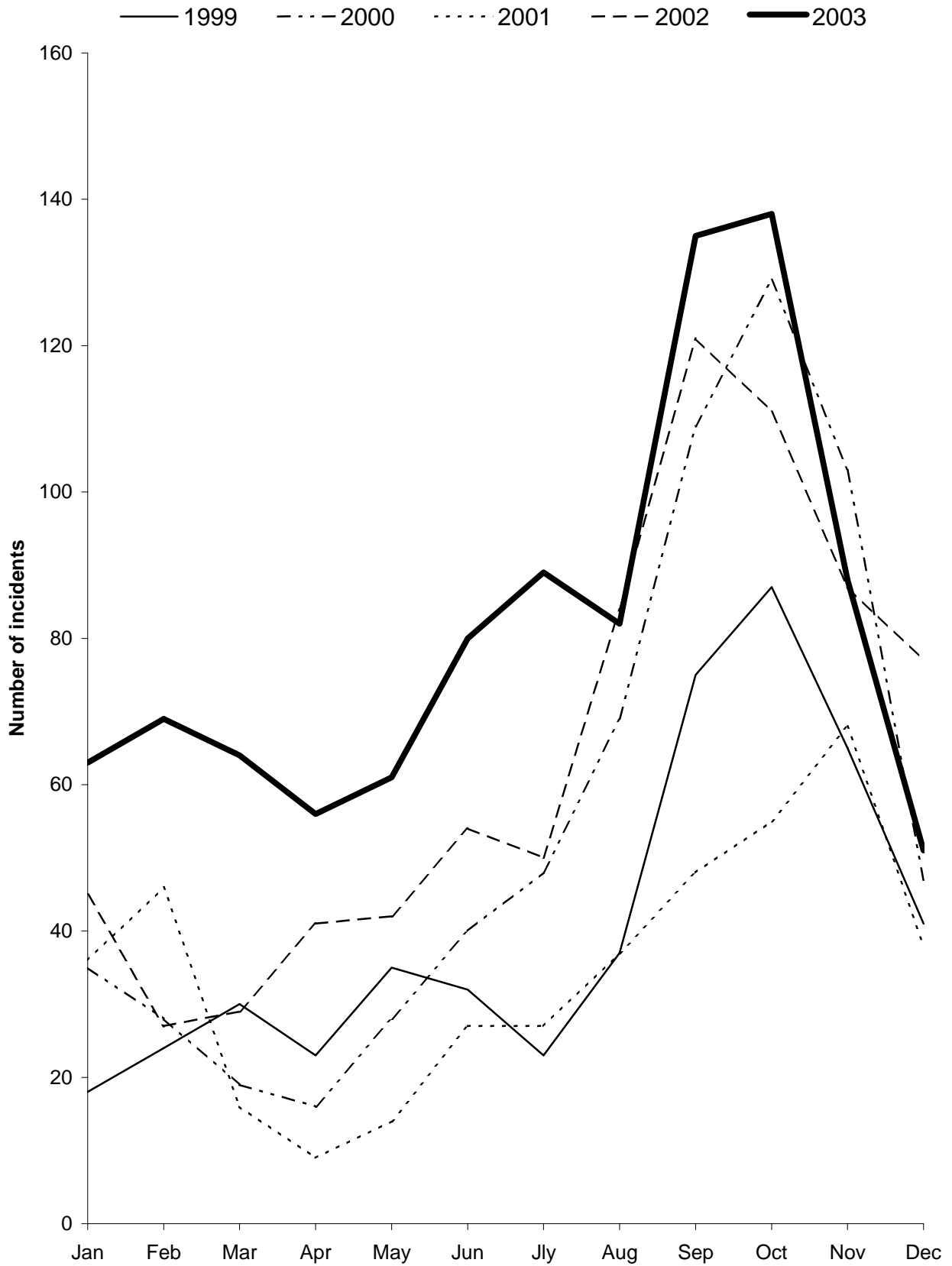
**Table 10: *Salmonella* in cattle on all premises (adults, calves & age unknown)**

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Paratyphi B var java	-	( -)	( -)	( -)	-	( -)	-	( -)	3	( 3)
Poona	2	( 2)	1	( 1)	-	( -)	-	( -)	1	( 1)
Reading	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Rubislaw	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Ruiru	-	( -)	1	( 2)	-	( -)	-	( -)	-	( -)
Saint Paul	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Schwarzengrund	1	( 1)	1	( 1)	-	( -)	1	( 2)	-	( -)
Stanley	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Stourbridge	-	( -)	-	( -)	-	( -)	-	( -)	2	( 2)
Tees	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Tennessee	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Thompson	5	( 6)	2	( 2)	3	( 3)	4	( 5)	1	( 1)
Typhimurium	297	( 491)	238	( 341)	148	( 205)	140	( 188)	126	( 183)
Vejle	-	( -)	-	( -)	-	( -)	4	( 8)	3	( 4)
Virchow	1	( 2)	1	( 1)	1	( 1)	1	( 1)	-	( -)
ENTERICA DIARIZONAE										
61:k:1,5	2	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
61:k:1,5,7	-	( -)	2	( 2)	-	( -)	1	( 1)	2	( 2)
61:-:1,5	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
61:-:1,5,7	-	( -)	-	( -)	1	( 1)	1	( 1)	1	( 1)
structure only	5	( 5)	8	( 9)	3	( 3)	8	( 11)	6	( 7)
rough strain	-	( -)	1	( 1)	3	( 3)	2	( 2)	5	( 5)
untyped	1	( 2)	3	( 3)	-	( -)	3	( 4)	-	( -)
TOTAL	878	(1270)	1014	(1369)	629	( 819)	1004	(1302)	1171	(1497)

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

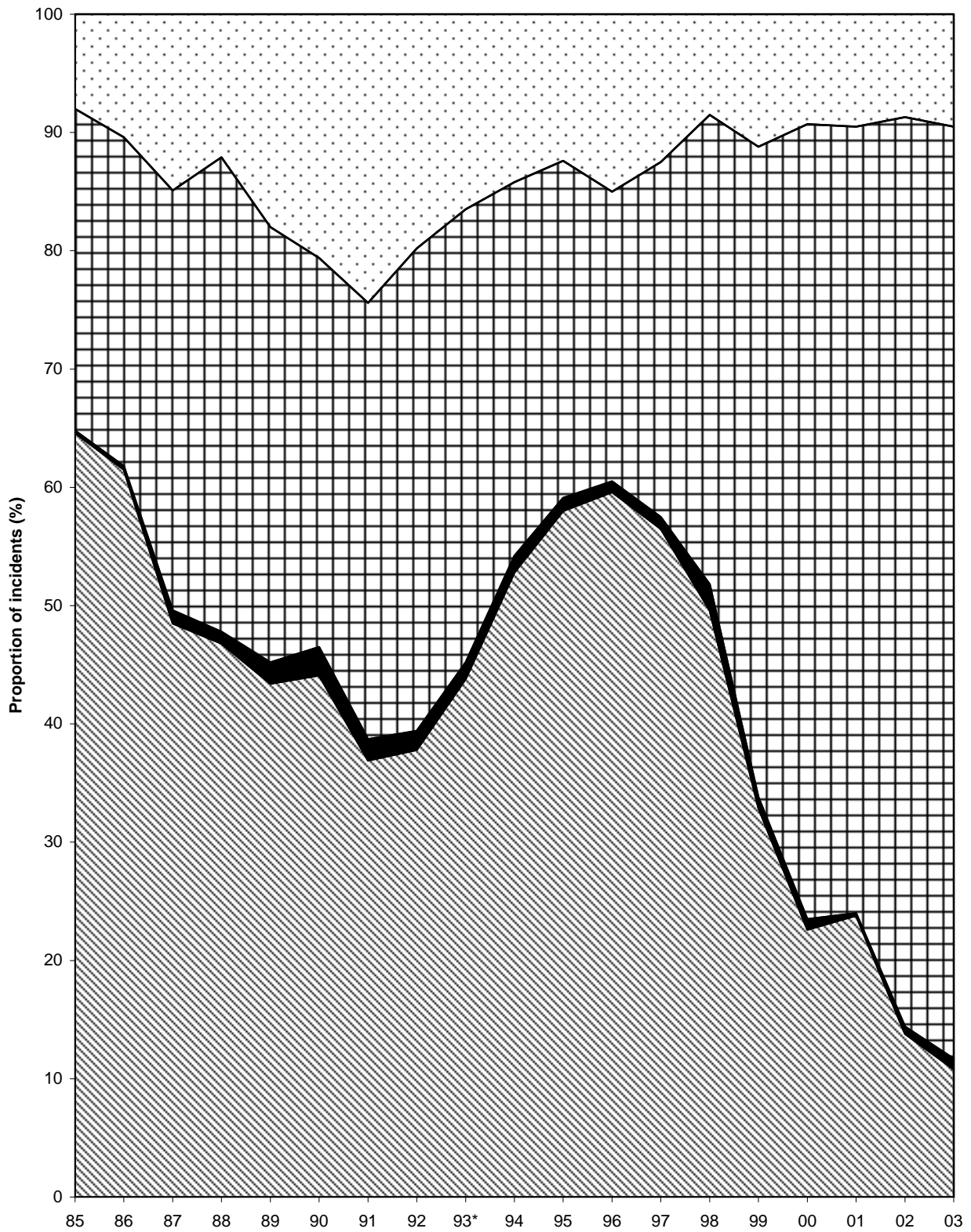
+ antigenic structure not stated

**Fig 6: Seasonality of S. Dublin in cattle  
(1999 - 2003)**



**Fig 7: S. Enteritidis, S. Typhimurium and S. Dublin as a proportion of all incident reports in cattle (1985 - 2003)**

■ S. Typhimurium ■ S. Enteritidis □ S. Dublin □ All other Salmonella serotypes



**Table 11: *Salmonella* in adult cattle on all premises**

<i>Salmonella</i> Incidents (Isolations)	1999	2000	2001*	2002	2003
<b>ENTERICA ENTERICA</b>					
Agama	13 ( 16)	8 ( 10)	7 ( 9)	10 ( 12)	6 ( 6)
Agona	4 ( 6)	1 ( 1)	3 ( 5)	1 ( 1)	1 ( 1)
Ajiobo	- ( -)	1 ( 1)	- ( -)	1 ( 1)	1 ( 1)
Anatum	5 ( 6)	1 ( 1)	2 ( 2)	11 ( 20)	21 ( 29)
Ank	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Bovis morbificans	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Binza	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Braenderup	1 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
Brandenburg	2 ( 3)	- ( -)	- ( -)	- ( -)	- ( -)
Bredeney	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Derby	1 ( 1)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
Dublin	251 ( 362)	355 ( 499)	219 ( 279)	388 ( 509)	352 ( 454)
Enteritidis	5 ( 8)	5 ( 5)	1 ( 1)	1 ( 1)	4 ( 5)
Give	2 ( 3)	2 ( 2)	- ( -)	1 ( 1)	-
Goldcoast	6 ( 9)	8 ( 9)	- ( -)	1 ( 1)	5 ( 6)
Hadar	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Havana	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Heidelberg	1 ( 1)	1 ( 1)	1 ( 2)	- ( -)	- ( -)
Infantis	- ( -)	2 ( 3)	- ( 2)	- ( -)	1 ( 1)
Kedougou	- ( -)	- ( -)	- ( -)	- ( -)	3 ( 6)
Kentucky	1 ( 1)	2 ( 2)	- ( -)	1 ( 1)	- ( -)
Mbandaka	3 ( 4)	- ( 3)	- ( -)	1 ( 1)	- ( -)
Meleagridis	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Montevideo	- ( -)	1 ( 3)	3 ( 3)	1 ( 1)	2 ( 2)
Nagoya	- ( -)	- ( -)	- ( -)	1 ( 1)	1 ( 1)
Newington	1 ( 2)	- ( -)	1 ( 1)	- ( -)	- ( -)
Newport	5 ( 7)	2 ( 2)	4 ( 4)	7 ( 8)	5 ( 5)
Oslo	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 3)
Poona	- ( -)	1 ( 1)	- ( -)	- ( -)	1 ( 1)
Ruiru	- ( -)	1 ( 2)	- ( -)	- ( -)	- ( -)
Saint Paul	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Schwarzengrund	1 ( 1)	1 ( 1)	- ( -)	1 ( 1)	- ( -)
Stourbridge	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
Tees	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Tennessee	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)

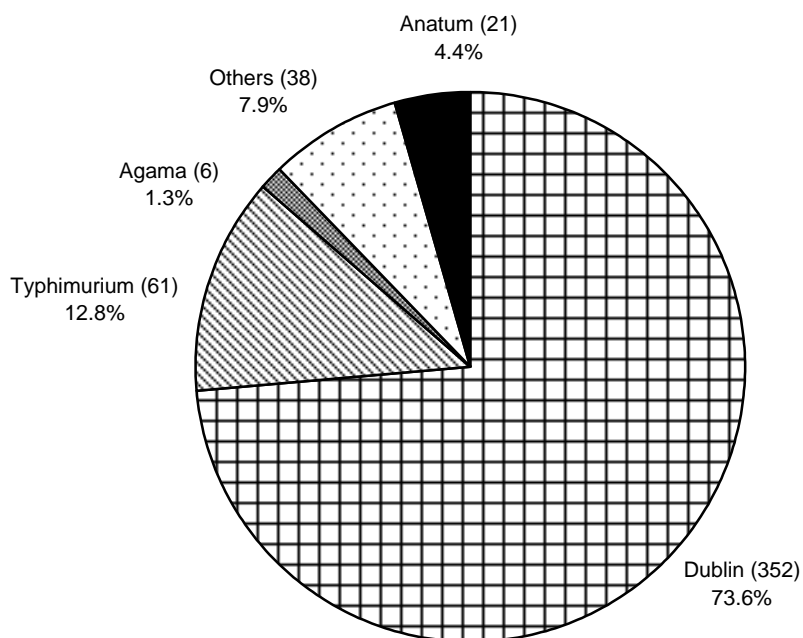
**Table 11: *Salmonella* in adult cattle on all premises**

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Thompson	4	( 5)	2	( 2)	3	( 3)	3	( 4)	-	( -)
Typhimurium	149	( 237)	120	( 165)	65	( 85)	74	( 89)	61	( 83)
Vejle	-	( -)	-	( -)	-	( -)	2	( 4)	2	( 3)
Virchow	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
ENTERICA DIARIZONAE										
61:k:1,5	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
61:-:1,5,7	-	( -)	-	( -)	-	( -)	-	( -)	2	( 2)
61:-:1,5	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
61:-:1,5,7	-	( -)	-	( -)	1	( 1)	1	( 1)	-	( -)
structure only	3	( 3)	3	( 3)	-	( -)	2	( 3)	2	( 2)
rough strain	-	( -)	-	( -)	2	( 2)	1	( 1)	2	( 2)
untyped	-	( 1)	3	( 3)	-	( -)	1	( 1)	-	( -)
TOTAL	464	( 685)	521	( 720)	315	( 402)	513	( 655)	478	( 617)

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

+ antigenic structure not stated

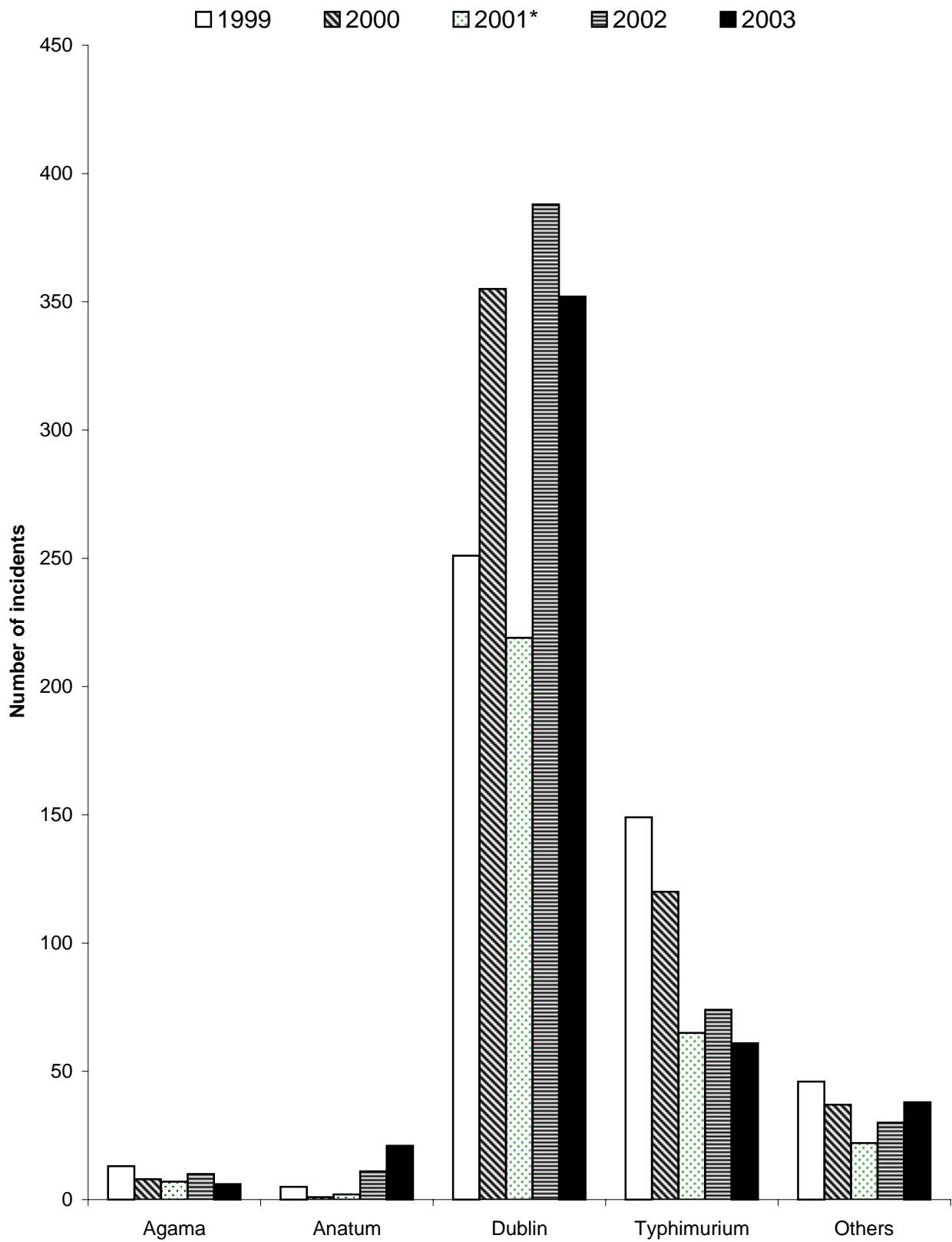
**Fig 8: Incidents of *Salmonella* serotypes in adult cattle in 2003**



**Table 12: Incidents of the top 4 *Salmonella* serotypes in adult cattle in 2003 as a % of all incidents compared to previous years**

Serotype	1999	2000	2001	2002	2003
S. Dublin %	54.1	68.1	69.5	75.6	73.6
S. Typhimurium %	32.1	23.0	20.6	14.4	12.8
S. Anatum %	1.1	0.2	0.6	2.1	4.4
S. Agama %	2.8	1.5	2.2	1.9	1.3
Total no. incidents	464	521	315	513	478

**Fig 9: Number of incidents of *Salmonella* serotypes in adult cattle (1999 - 2003)**



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

**Table 13: *Salmonella* in calves on all premises**

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Agama	4	( 7)	9	( 10)	5	( 6)	2	( 5)	3	( 4)
Agona	2	( 2)	4	( 4)	1	( 1)	2	( 2)	3	( 3)
Ajiobo	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Anatum	1	( 3)	1	( 2)	-	( 1)	4	( 5)	7	( 7)
Bovis morbificans	2	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
Binza	-	( -)	-	( -)	-	( -)	-	( -)	-	( -)
Braenderup	-	( -)	1	( 1)	1	( 1)	-	( -)	-	( -)
Brandenburg	4	( 5)	2	( 2)	-	( -)	-	( -)	-	( -)
Derby	1	( 1)	-	( -)	1	( 2)	-	( -)	1	( 1)
Dublin	180	( 223)	265	( 321)	150	( 183)	300	( 353)	362	( 431)
Durham	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Enteritidis	2	( 2)	2	( 2)	-	( -)	4	( 4)	3	( 4)
Give	-	( -)	2	( 2)	-	( -)	-	( -)	-	( -)
Goldcoast	-	( -)	2	( 2)	3	( 3)	-	( -)	1	( 1)
Havana	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Heidelberg	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Indiana	-	( -)	-	( -)	-	( -)	-	( -)	-	( -)
Infantis	1	( 1)	-	( -)	-	( -)	1	( 1)	-	( -)
Kedougou	2	( 2)	1	( 1)	-	( -)	-	( -)	1	( 3)
Kentucky	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Kimuenza	-	( -)	-	( -)	-	( -)	-	( -)	2	( 4)
Kottbus	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Livingstone	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Mbandaka	3	( 3)	-	( -)	-	( -)	1	( 1)	-	( -)
Montevideo	1	( 1)	3	( 3)	-	( -)	-	( -)	2	( 2)
Nagoya	-	( -)	-	( -)	1	( 1)	1	( 1)	-	( -)
Newington	2	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
Newport	1	( 1)	2	( 4)	2	( 2)	2	( 2)	-	( -)
Orion	-	( -)	1	( 3)	-	( -)	-	( -)	-	( -)
Oslo	-	( -)	-	( -)	-	( -)	-	( -)	1	( 2)
Paratyphi B var java	-	( -)	1	( 1)	-	( -)	-	( -)	1	( 1)
Poona	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Reading	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Schwarzengrund	-	( -)	-	( -)	-	( -)	-	( -)	-	( -)

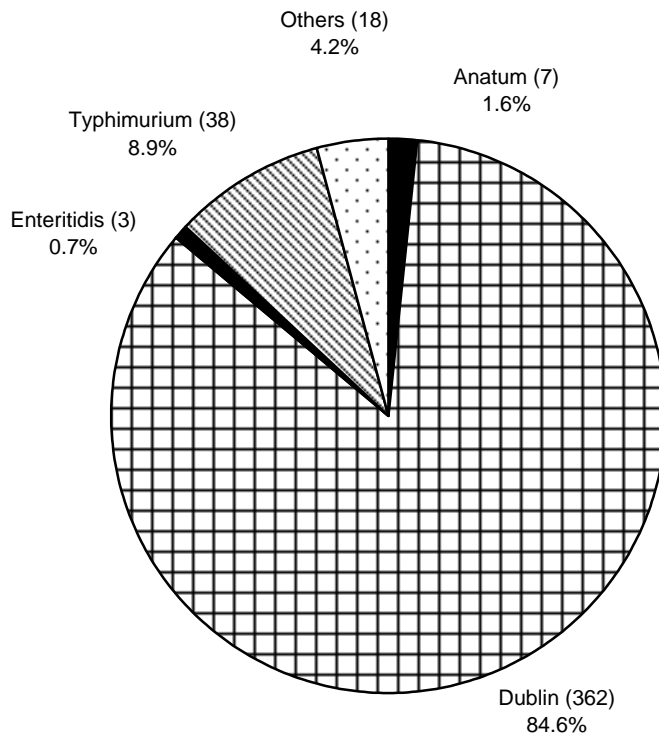
**Table 13: *Salmonella* in calves on all premises**

<i>Salmonella</i> Incidents (Isolations)	1999		2000		2001*		2002		2003	
ENTERICA ENTERICA										
Thompson	1	( 1)	-	( -)	-	( -)	1	( 1)	-	( -)
Typhimurium	125	( 183)	86	( 109)	47	( 60)	45	( 56)	38	( 51)
Virchow	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
ENTERICA DIARIZONAE										
61:k:1,5	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
61:k:1,5,7	-	( -)	2	( 2)	-	( -)	-	( -)	-	( -)
structure only	2	( 2)	2	( 3)	2	( 2)	5	( 7)	1	( 2)
rough strain	-	( -)	1	( 1)	1	( 1)	1	( 1)	2	( 2)
untyped	1	( 1)	-	( -)	-	( -)	1	( 1)	-	( -)
TOTAL	339	( 446)	389	( 475)	216	( 265)	372	( 442)	428	( 518)

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

+ antigenic structure not stated

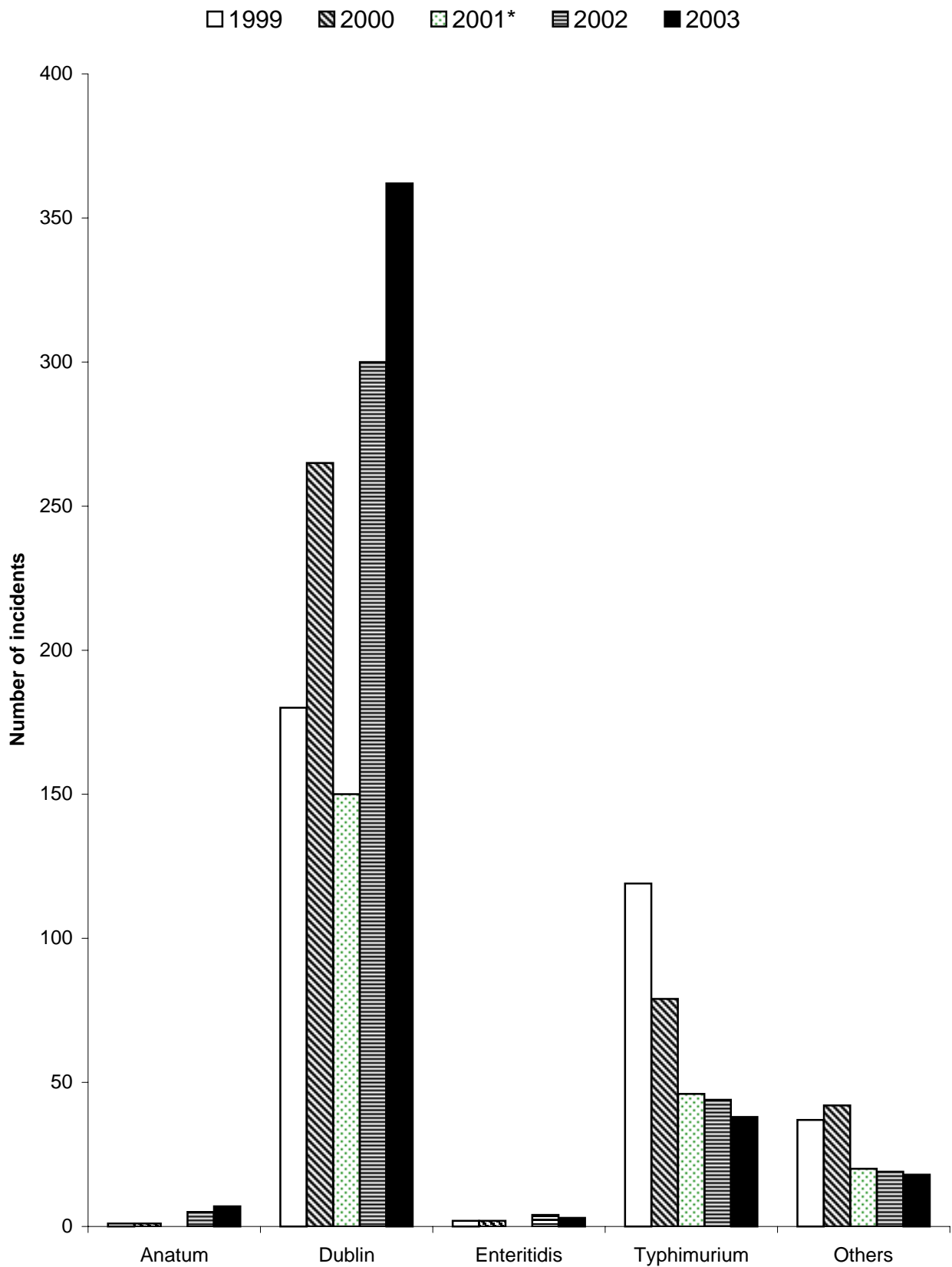
**Fig 10: Incidents of *Salmonella* serotypes in calves in 2003**



**Table 14: Incidents of the top 4 *Salmonella* serotypes in calves in 2003 as a % of all incidents compared to previous years**

Serotype	1999	2000	2001	2002	2003
S. Dublin %	53.1	68.1	69.4	80.6	84.6
S. Typhimurium %	36.9	22.1	21.8	12.1	8.9
S. Anatum %	0.3	0.3	0	1.1	1.6
S. Agona %	0.6	1.0	0.5	0.5	0.7
S. Enteritidis %	0.6	0.5	0	1.1	0.7
Total no. incidents	339	389	216	372	428

**Fig 11: Number of incidents of *Salmonella* serotypes in calves (1999 - 2003)**



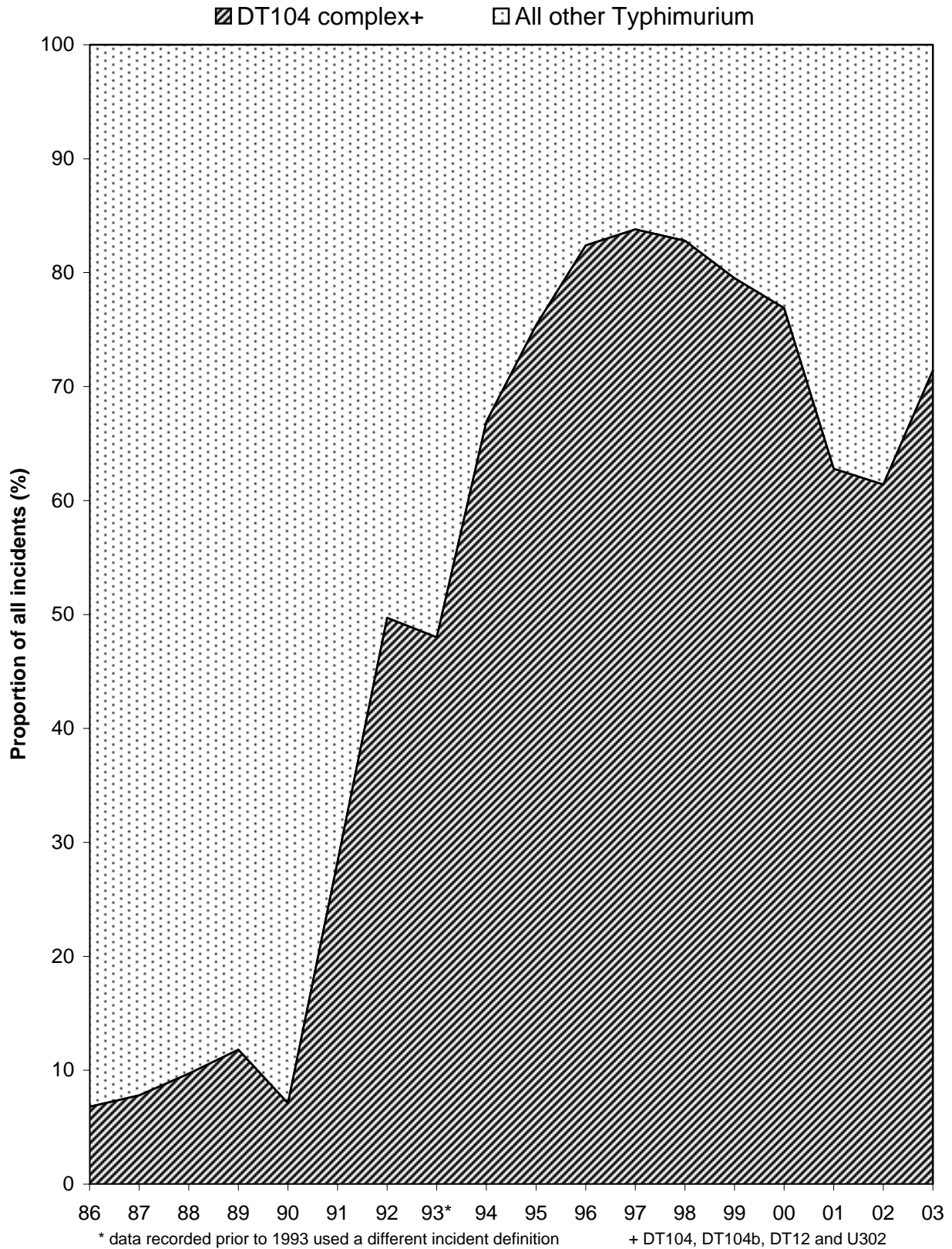
\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 15: S. Typhimurium in cattle on all premises (all ages)**

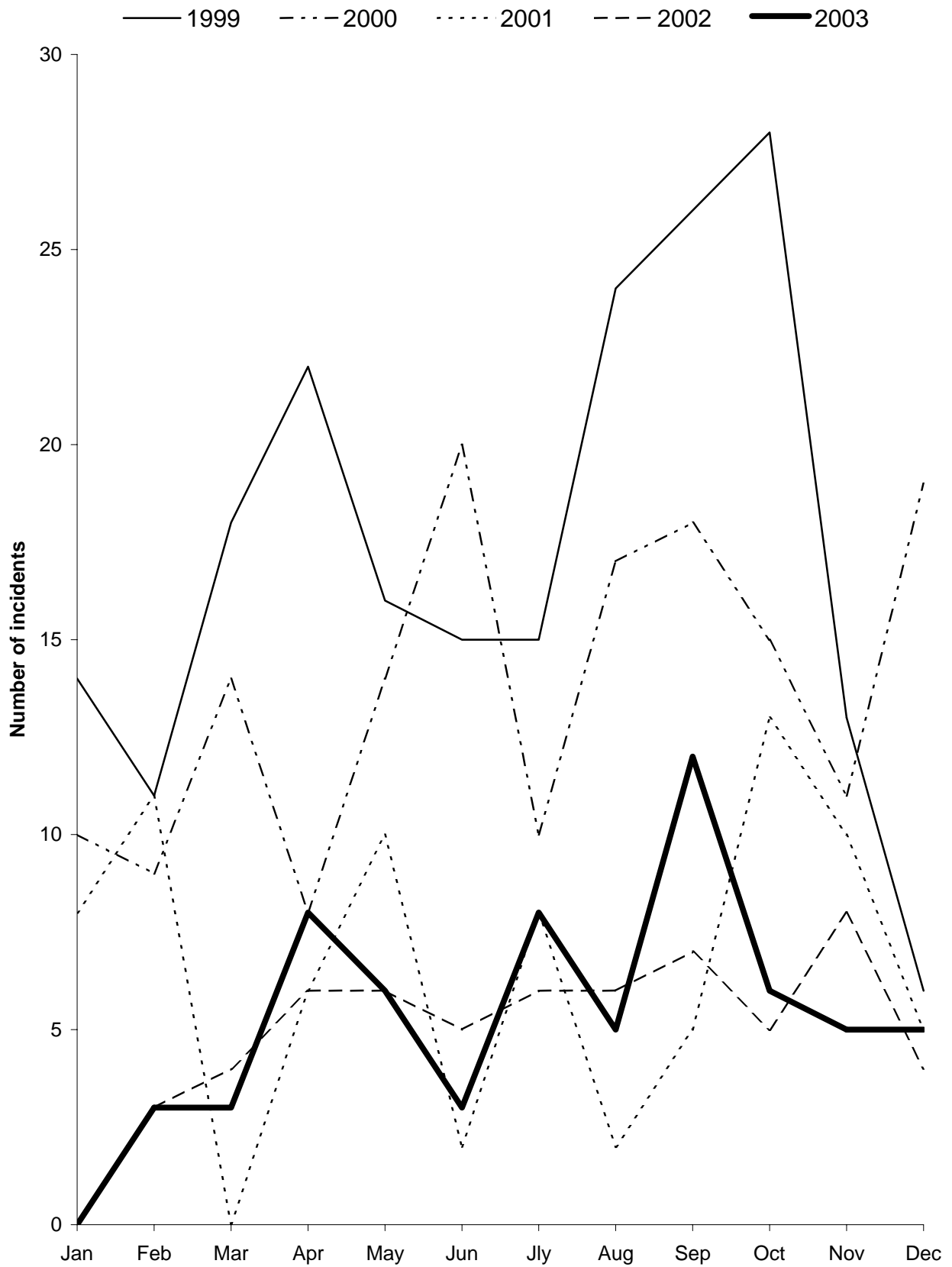
Definitive Types Incidents (Isolations)	1999	2000	2001*	2002	2003
2	- (-)	- (-)	- (-)	1 (1)	- (-)
8	1 (1)	- (-)	1 (1)	- (-)	1 (1)
12	7 (9)	- (-)	2 (2)	6 (8)	5 (6)
17	- (-)	1 (1)	- (-)	- (-)	- (-)
40	- (-)	1 (1)	1 (1)	2 (2)	2 (2)
41	3 (3)	1 (2)	1 (1)	1 (1)	2 (2)
49	- (-)	1 (1)	- (-)	- (-)	- (-)
49b	1 (1)	- (-)	- (-)	- (-)	1 (2)
56	- (-)	- (-)	- (-)	2 (2)	1 (1)
67	- (-)	1 (1)	- (-)	- (-)	- (-)
69	- (-)	- (-)	2 (3)	- (-)	- (-)
99	- (-)	1 (1)	- (-)	- (-)	- (-)
103	- (-)	- (-)	1 (1)	- (-)	- (-)
104	208 (366)	164 (244)	80 (118)	60 (89)	67 (107)
104b	9 (9)	4 (6)	5 (7)	5 (10)	7 (10)
104c	- (-)	1 (1)	- (-)	- (-)	- (-)
108	1 (1)	1 (1)	- (-)	- (-)	- (-)
120	5 (6)	7 (7)	6 (6)	4 (4)	1 (1)
135	3 (3)	- (-)	- (-)	- (-)	- (-)
166	- (-)	- (-)	- (-)	- (-)	1 (1)
169	- (-)	- (-)	- (-)	- (-)	1 (1)
170	- (-)	5 (5)	3 (5)	6 (7)	2 (2)
193	12 (15)	11 (17)	6 (10)	3 (6)	4 (4)
193a	- (-)	- (-)	- (-)	2 (3)	2 (6)
195	1 (1)	- (-)	- (-)	- (-)	1 (1)
208	- (-)	1 (1)	3 (6)	5 (6)	1 (1)
U288	- (-)	- (-)	- (-)	- (-)	2 (2)
U302	14 (35)	14 (21)	6 (9)	15 (19)	11 (16)
U308a	- (-)	- (-)	2 (2)	- (-)	- (-)
U310	- (-)	- (-)	1 (1)	- (-)	6 (6)
U311	- (-)	- (-)	- (-)	- (-)	1 (1)
RDNC	- (-)	1 (1)	3 (3)	10 (11)	1 (1)
NOPT	10 (14)	1 (1)	1 (1)	- (-)	1 (1)
UNTY	22 (27)	22 (29)	20 (23)	9 (9)	5 (5)
Untyped	- (-)	- (-)	4 (5)	9 (10)	- (-)
TOTAL	297 (491)	238 (341)	148 (205)	140 (188)	126 (180)

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

**Fig 12: *Salmonella* Typhimurium DT104 and related strains as a proportion of all reports of *Salmonella* Typhimurium in cattle 1986 - 2003**



**Fig 13: Seasonality of *S. Typhimurium* DT104 in cattle  
(1999 - 2003)**

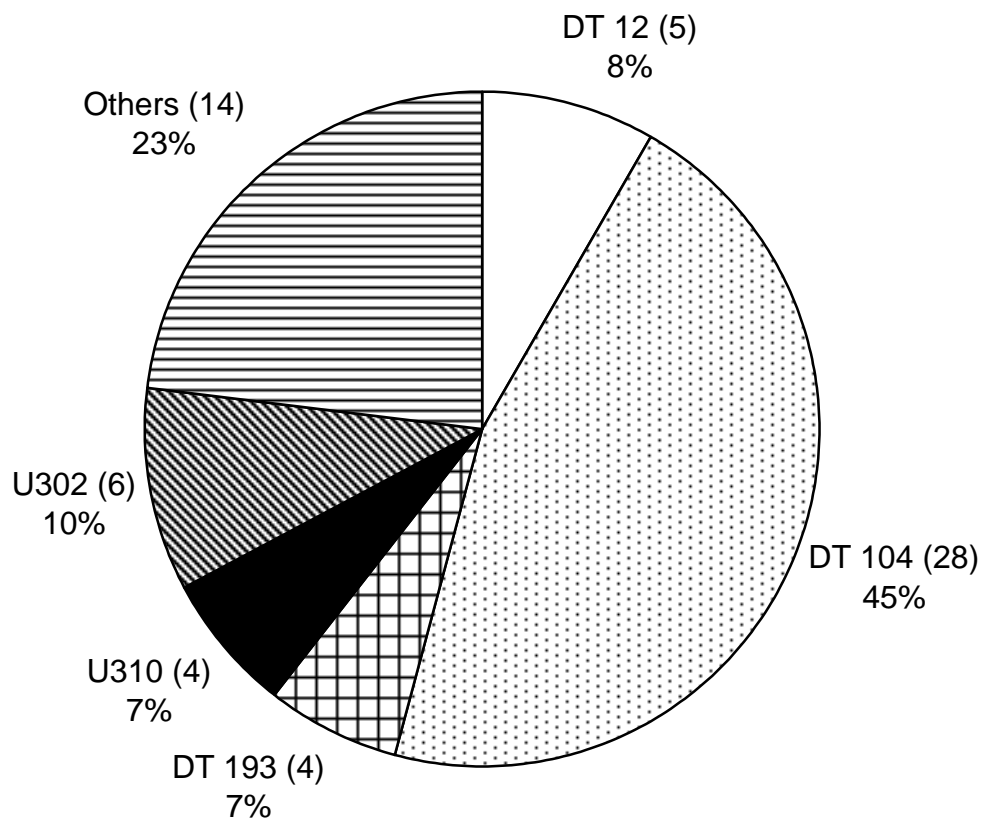


**Table 16: S.Typhimurium in adult cattle on all premises**

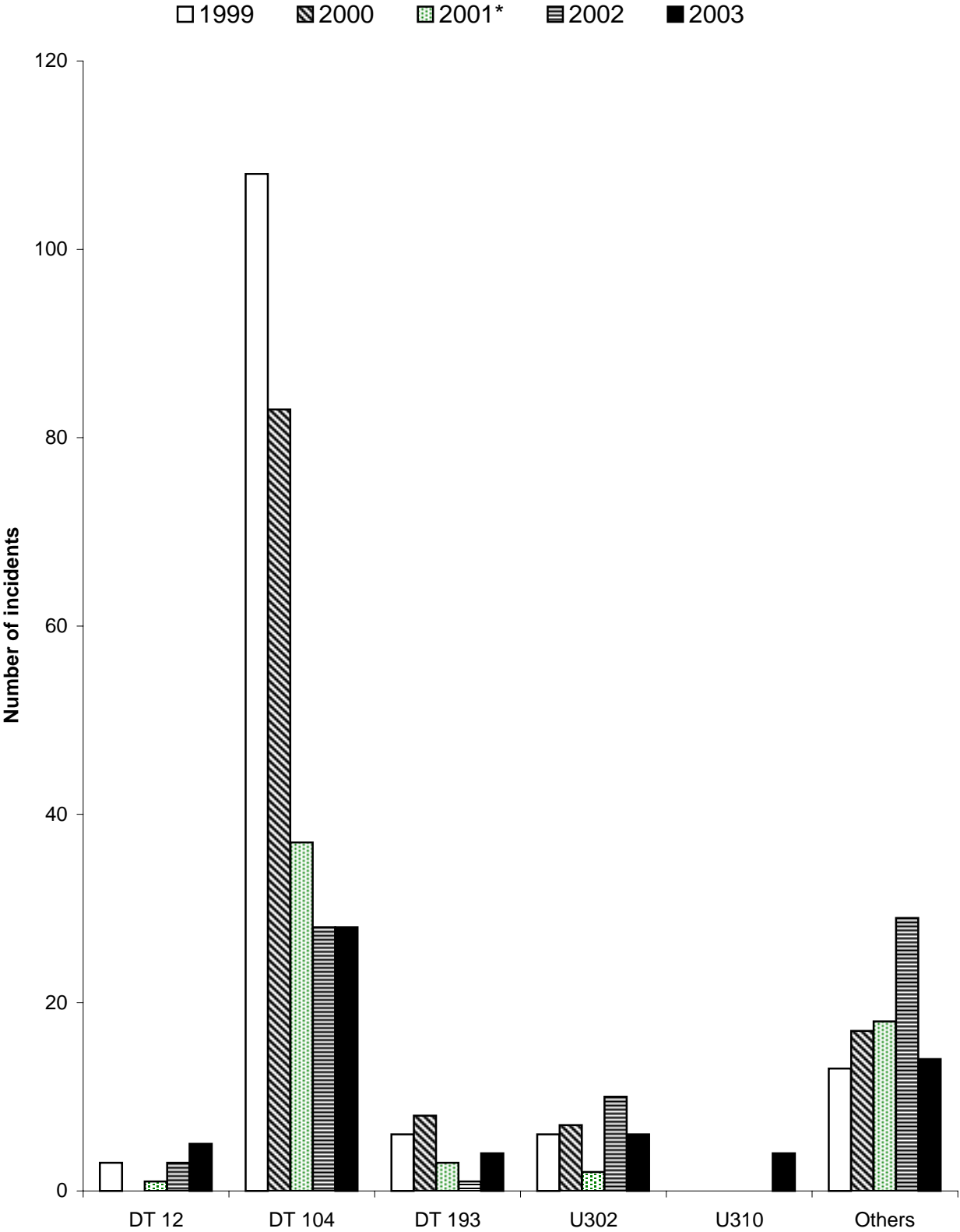
Definitive Types Incidents (Isolations)	1999	2000	2001*	2002	2003
8	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
12	3 ( 5)	- ( -)	1 ( 1)	3 ( 4)	5 ( 6)
40	- ( -)	- ( -)	- ( -)	2 ( 2)	- ( -)
41	2 ( 2)	- ( -)	1 ( 1)	1 ( 1)	1 ( 1)
49	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 2)
49b	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
67	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
69	- ( -)	- ( -)	1 ( 2)	- ( -)	- ( -)
99	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
104	108 ( 177)	82 ( 117)	37 ( 48)	28 ( 38)	28 ( 41)
104b	5 ( 5)	1 ( 1)	2 ( 2)	2 ( 3)	3 ( 4)
104c	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
108	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
120	1 ( 1)	2 ( 2)	1 ( 1)	2 ( 2)	- ( -)
135	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
166	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
169	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
170	- ( -)	3 ( 3)	2 ( 4)	5 ( 5)	- ( -)
193	6 ( 7)	8 ( 11)	3 ( 4)	1 ( 1)	4 ( 4)
193a	- ( -)	- ( -)	- ( -)	1 ( 2)	2 ( 4)
195	1 ( 1)	- ( -)	- ( -)	- ( -)	1 ( 1)
208	- ( -)	1 ( 1)	3 ( 4)	3 ( 4)	1 ( 3)
U302	6 ( 19)	7 ( 9)	2 ( 3)	10 ( 11)	6 ( 8)
U308a	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
U310	- ( -)	- ( -)	- ( -)	- ( -)	4 ( 4)
U311	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
RDNC	- ( -)	1 ( 1)	1 ( 1)	7 ( 7)	- ( -)
NOPT	4 ( 5)	- ( -)	- ( -)	- ( -)	- ( -)
UNTY	10 ( 11)	11 ( 16)	9 ( 11)	5 ( 5)	2 ( 2)
Untyped	- ( -)	- ( -)	1 ( 2)	4 ( 4)	- ( -)
<b>TOTAL</b>	<b>150 ( 237)</b>	<b>120 ( 165)</b>	<b>65 ( 85)</b>	<b>74 ( 89)</b>	<b>61 ( 83)</b>

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

**Fig 14: Incidents of Salmonella Typhimurium definitive types in adult cattle in 2003**



**Fig 15: Incidents of *Salmonella* Typhimurium definitive types in adult cattle (1999 - 2003)**



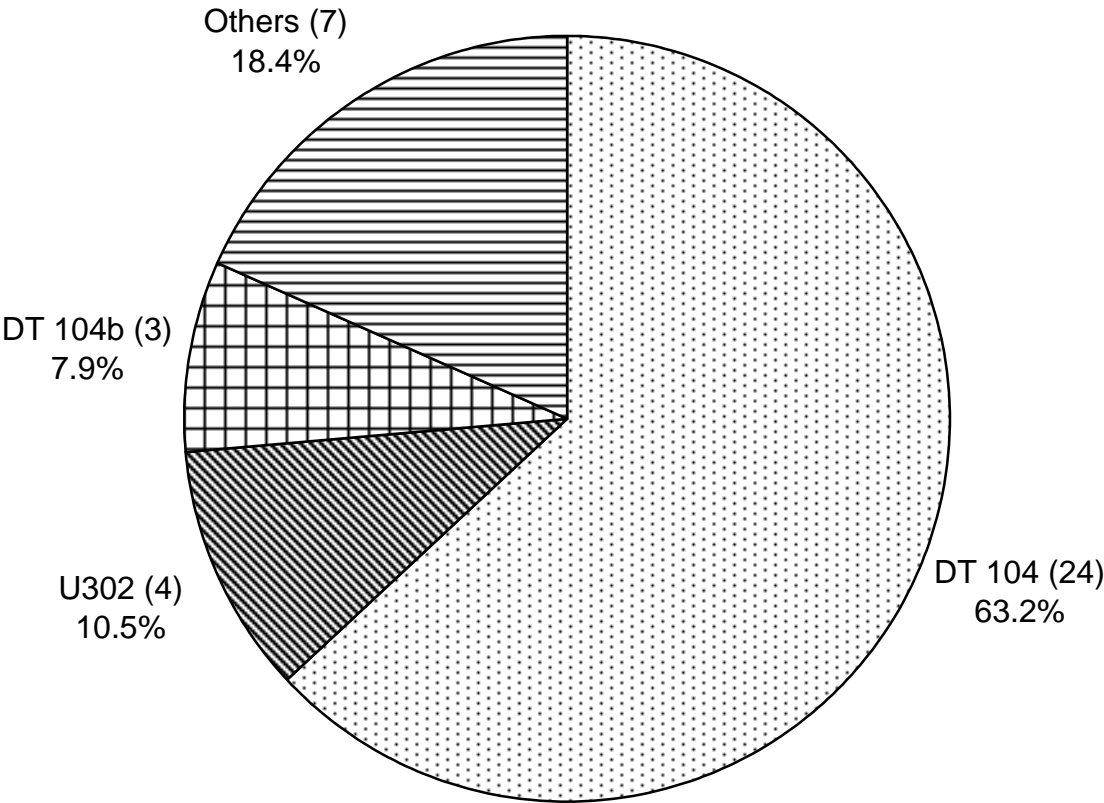
\* 2001 data may not be comparable due to uncertain impact of FMD epidemic

**Table 17: S.Typhimurium in calves on all premises**

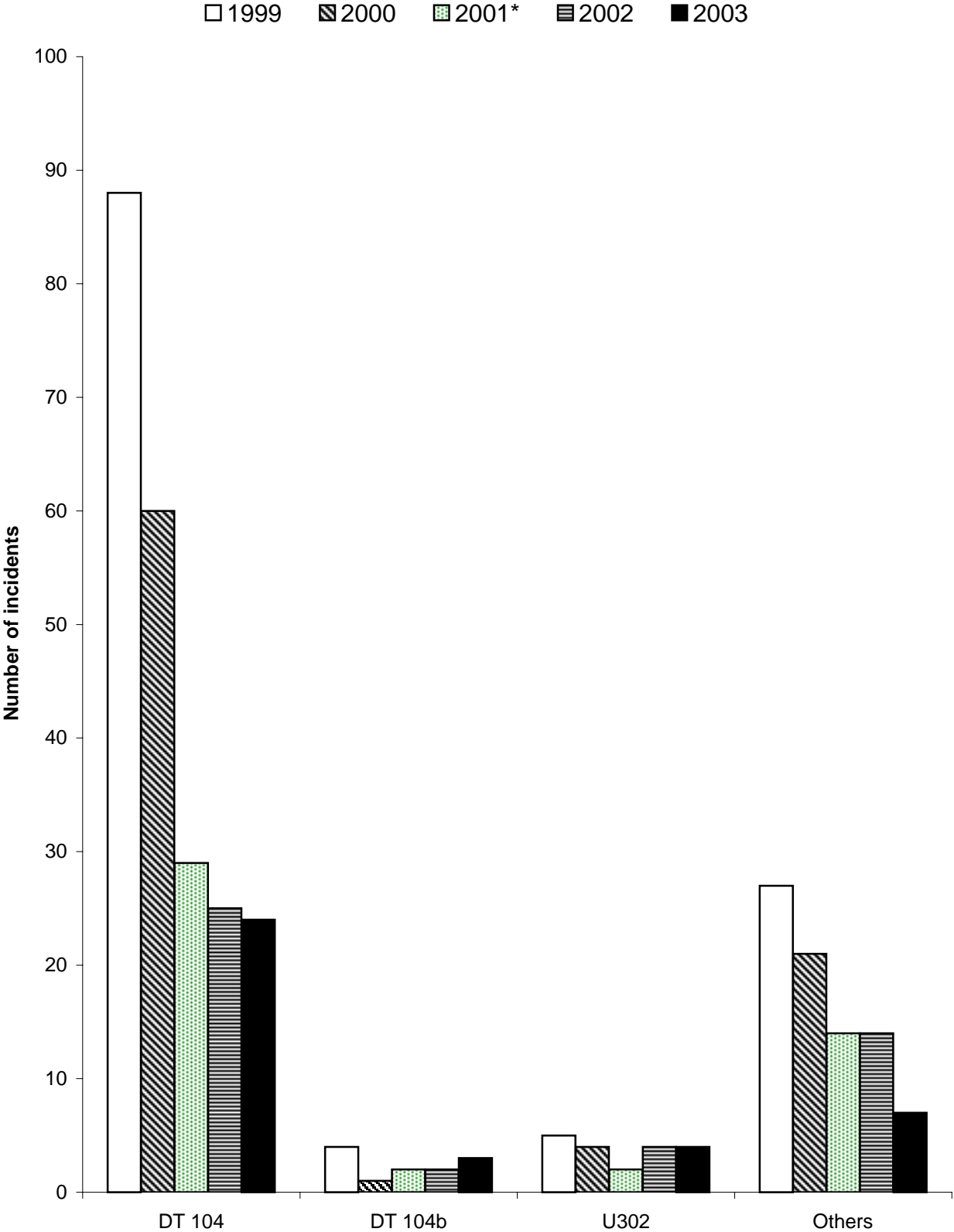
Definitive Types Incidents (Isolations)	1999	2000	2001*	2002	2003
8	- ( -)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
12	4 ( 4)	- ( -)	- ( -)	1 ( 2)	- ( -)
17	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
40	- ( -)	1 ( 1)	- ( -)	- ( -)	1 ( 1)
41	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
56	- ( -)	- ( -)	- ( -)	2 ( 2)	1 ( 1)
69	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
103	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
104	88 ( 138)	60 ( 80)	29 ( 39)	25 ( 32)	24 ( 33)
104b	4 ( 4)	1 ( 1)	2 ( 3)	2 ( 4)	3 ( 4)
108	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
120	2 ( 3)	4 ( 4)	3 ( 3)	2 ( 2)	- ( -)
135	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
170	- ( -)	1 ( 1)	1 ( 1)	- ( 1)	- ( -)
193	6 ( 7)	3 ( 3)	1 ( 1)	1 ( 1)	- ( -)
193a	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( 1)
204	- ( -)	- ( -)	- ( -)	- ( -)	- ( -)
208	- ( -)	- ( -)	- ( 1)	1 ( 1)	- ( -)
U288	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
U302	5 ( 9)	5 ( 7)	2 ( 3)	4 ( 4)	4 ( 6)
U308a	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
U310	- ( -)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
RDNC	- ( -)	- ( -)	- ( -)	2 ( 2)	- ( -)
NOPT	2 ( 3)	1 ( 1)	- ( -)	- ( -)	- ( -)
UNTY	11 ( 13)	8 ( 9)	2 ( 2)	3 ( 3)	2 ( 2)
Untyped	- ( -)	- ( -)	2 ( 2)	1 ( 1)	- ( -)
<b>TOTAL</b>	<b>124 ( 183)</b>	<b>86 ( 109)</b>	<b>47 ( 60)</b>	<b>45 ( 56)</b>	<b>38 ( 51)</b>

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

**Fig 16: Incidents of *Salmonella* Typhimurium definitive types in calves in 2003**



**Fig 17: Incidents of *Salmonella* Typhimurium definitive types in calves (1999 - 2003)**



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

**Table 18: S. Enteritidis in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	1999		2000		2001*		2002		2003	
1	-	( -)	1	( 1)	-	( -)	-	( -)	1	( 3)
4	6	( 7)	3	( 3)	1	( 1)	2	( 2)	1	( 1)
5	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
6	1	( 3)	-	( -)	-	( -)	2	( 2)	-	( -)
6a	-	( -)	-	( -)	-	( -)	1	( 1)	1	( 1)
7	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
8	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
9a	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
11	1	( 1)	1	( 1)	-	( -)	-	( -)	1	( 1)
13a	-	( -)	-	( -)	-	( -)	1	( 1)	5	( 6)
21	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
24	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
<b>TOTAL</b>	<b>8</b>	<b>( 11)</b>	<b>9</b>	<b>( 9)</b>	<b>1</b>	<b>( 1)</b>	<b>6</b>	<b>( 6)</b>	<b>11</b>	<b>( 14)</b>

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

**Table 19: S. Enteritidis in adult cattle on all premises**

Phage Types Incidents (Isolations)	1999		2000		2001*		2002		2003	
1	-	( -)	1	( 1)	-	( -)	-	( -)	1	( 2)
4	4	( 5)	2	( 2)	1	( 1)	1	( 1)	-	( -)
5	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
6	1	( 3)	-	( -)	-	( -)	-	( -)	-	( -)
7	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
8	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
13a	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
24	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
<b>TOTAL</b>	<b>5</b>	<b>( 8)</b>	<b>5</b>	<b>( 5)</b>	<b>1</b>	<b>( 1)</b>	<b>1</b>	<b>( 1)</b>	<b>4</b>	<b>( 5)</b>

**Table 20: S. Enteritidis in calves on all premises**

Phage Types Incidents (Isolations)	1999		2000		2001*		2002		2003	
4	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
6	-	( -)	-	( -)	-	( -)	2	( 2)	-	( -)
6a	-	( -)	-	( -)	-	( -)	1	( 1)	1	( 1)
9a	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
11	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
13a	-	( -)	-	( -)	-	( -)	1	( 1)	2	( 3)
21	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
<b>TOTAL</b>	<b>2</b>	<b>( 2)</b>	<b>2</b>	<b>( 2)</b>	<b>-</b>	<b>( -)</b>	<b>4</b>	<b>( 4)</b>	<b>3</b>	<b>( 4)</b>

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

**Table 21: S. Hadar in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	1999	2000	2001*	2002	2003
9	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
NOPT	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Totals	1 ( 1)	- ( -)	- ( -)	- ( -)	1 ( 1)

**Table 22: S. Thompson in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	1999	2000	2001*	2002	2003
1	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
1a	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
3	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
23	- ( -)	1 ( 1)	2 ( 2)	- ( -)	- ( -)
RDNC	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
NOPT	2 ( 3)	- ( -)	1 ( 1)	4 ( 5)	- ( -)
TOTAL	5 ( 6)	2 ( 2)	3 ( 3)	4 ( 5)	1 ( 1)

**Table 23: S. Virchow in cattle on all premises (all ages)**

Phage Types Incidents (Isolations)	1999	2000	2001*	2002	2003
9	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
26	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
50	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
NOPT	1 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
TOTAL	1 ( 2)	1 ( 1)	1 ( 1)	1 ( 1)	- ( -)

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