

## 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.

There were 8.66 million cattle in Great Britain in 2002, 2.9% less than in 2001 and 5.7% less than in 2000. Many cattle were slaughtered during the FMD outbreak in 2001. 670,495 cattle were slaughtered in the Over Thirty Months Scheme of the Government's control programme for Bovine Spongiform Encephalopathy (BSE). 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 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. Furthermore, Government movement restrictions and closure of markets post-FMD led to overstocking on some farms in early 2002. However, additional changes post-FMD include increased requirements to clean and disinfect vehicles and livestock movement restrictions, both of which would be expected to reduce *Salmonella* transmission between premises. 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 2002 (43,665) back to the level in 2000 (43,714). In 2001 there were fewer diagnostic submissions (31,280) due to the outbreak of FMD (see Introduction). During 2002, many farms that were de-populated during the FMD outbreak have been re-stocked and in some cases clinical disease including salmonellosis has been reported subsequently. *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.

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 been decreasing in recent years. As in

previous years, the majority (94%) of *Salmonella* incidents (n = 1004) reported in cattle were from samples taken for clinical diagnostic purposes (see Table 1, Chapter 1) and came from cattle on farms. There were 60% more *Salmonella* incidents in cattle reported in 2002 than in 2001, probably due to the increase in diagnostic submission numbers post-FMD. However, in 2002, some serotypes were reported in cattle for the first time in the last five years including *S. Ank*, *S. Bredeney*, *S. Kottbus* and *S. Vejle*. Of the 1004 *Salmonella* incidents in cattle, 51% were in adult cattle, 37% in calves and 12% in cattle of unknown age. For the fourth year, *S. Dublin* was the most common (76% of incidents) serotype reported in cattle and was the second most common serotype reported in sheep (see Chapter 2.2).

### ***Salmonella* Dublin**

For the fourth consecutive year, *S. Dublin* was the most common serotype in adult cattle (76% of incidents; Figure 8) and calves (81 % of incidents; Figure 10). The relative proportion of *S. Dublin* in adult cattle increased (from 70 to 76%) whereas the relative proportion of *S. Typhimurium* decreased (from 21 to 14%) in 2002 compared to 2001 (Table 12). Similar changes were observed for reports in calves (Table 14). There appear to be regional differences in reports, for example many *S. Dublin* incidents have been reported in southwest Scotland where some farms have been affected for the first time in recent years. 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. *S. Dublin* was the second most common infectious cause of bovine fetopathy in GB (14% of diagnosed submissions; VIDA 2002).

### ***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 serotype, which is steadily declining, is similar in adult cattle (14%) and calves (12%) (Tables 12 and 14). Several definitive types (DT69, DT103, U308a and U310) were reported in 2001 for the first time since 1985/6, but there have been no further reports of these types in 2002 in cattle (Table 15). Some multiple-resistant DT193 and U302 strains have been isolated. Interestingly there has been an increase in the number of RDNC strains, which may represent new, as yet, untyped strain(s). DT104 remains the most common definitive type

(43% of incidents). 57% of incidents were due to non-DT 104 phage types including one incident of DT2, which is unusual in cattle, and was reported for the first time in cattle (of unknown age) since 1997.

### **Other serotypes**

*Salmonella* Enteritidis, *S. Hadar*, *S. Thompson* and *S. Virchow* are phage typed routinely. There were 6 reported incidents of *S. Enteritidis* (Table 18). These comprised two incidents of DT4 in adult and other cattle, two incidents of DT6 in calves, one incident of DT6a in calves and one incident of DT13a in calves. All these phage types of *S. Enteritidis* have been reported in cattle in the last five years except DT13a which was last reported in cattle in 1994. There were no incidents of *S. Hadar* (Table 21), four incidents of *S. Thompson* (not phage typed; NOPT; Table 23) and one incident of *S. Virchow* PT26 (age of cattle unknown; Table 23). The latter strain was last reported in cattle in 1997.

There was an increase in the number of *S. Anatum* incidents, particularly in adult cattle (2.1% incidents; Table 12). *Salmonella* Ank (never previously reported in GB livestock), *S. Bredeney* (since 1997), *S. Kottbus* (never previously reported in cattle through routine surveillance) and *S. Vejle* (never previously reported in any livestock species) were reported in cattle (adult and other ages) for the first time in recent years. *S. Kottbus* was isolated from a diagnostic sheep sample in 1996 and also on a dairy farm during a research project in 2000. *S. Vejle* was also isolated from a dog living in a different county to the affected cattle. This serotype was last reported in 1990 from chickens and has been seen infrequently in a variety of livestock species and humans in different countries including Germany, Senegal and Israel. There were four incidents of *S. Vejle*, three of which originated in the same dairy/dealer enterprise and were associated with clinical disease and mortality in adult cattle, particularly peri-parturient cattle. *S. Ank*, which was associated with clinical disease in infected cattle in southern England, is a very rare serotype worldwide and has been isolated from wildlife and humans in Africa. There was one incident of *S. Kottbus* in calves (separate incidents of *S. Kottbus* were also reported in sheep and a badger). There were two incidents of *S. Nagoya* in southwest England from where it was reported last year for the first time since 1996.

There were 11 incidents of *Salmonella* Newport in cattle, representing 1.4% of incidents in adult cattle and 0.5% of incidents in calves. 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 salmonellas, 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, is establishing case definitions and protocols for fast-tracking the identification and reporting of the organism. In addition, new sampling protocols and epidemiological questionnaires are being developed to be used by the Nominated Officers investigating incidents associated with MDRSN.

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

<i>Salmonella</i> Incidents (Isolations)	1998		1999		2000		2001*		2002	
ENTERICA ENTERICA										
Agama	15	( 25)	20	( 26)	20	( 25)	13	( 17)	13	( 19)
Agona	2	( 3)	6	( 8)	5	( 5)	4	( 7)	4	( 4)
Ajiobo	-	( -)	-	( -)	1	( 1)	-	( -)	2	( 2)
Anatum	6	( 7)	6	( 9)	3	( 5)	3	( 4)	15	( 26)
Ank	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Bovis morbificans	2	( 2)	3	( 3)	-	( -)	1	( 1)	-	( -)
Binza	3	( 3)	1	( 1)	2	( 2)	-	( -)	-	( -)
Braenderup	-	( -)	1	( 2)	1	( 1)	1	( 1)	-	( -)
Brandenburg	1	( 1)	6	( 8)	4	( 4)	1	( 1)	-	( -)
Bredenev	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Derby	2	( 2)	2	( 2)	-	( -)	2	( 3)	-	( -)
Dublin	391	( 532)	473	( 641)	671	( 899)	421	( 539)	768	( 985)
Durham	-	( -)	1	( 2)	-	( -)	1	( 1)	-	( -)
Enteritidis	22	( 25)	8	( 11)	9	( 9)	1	( 1)	6	( 6)
Give	3	( 4)	2	( 3)	4	( 4)	1	( 1)	1	( 1)
Goerlitz	2	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
Goldcoast	6	( 9)	7	( 11)	11	( 13)	4	( 4)	3	( 5)
Hadar	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Havana	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Heidelberg	-	( -)	2	( 2)	2	( 2)	1	( 2)	1	( 1)
Indiana	1	( 3)	-	( -)	-	( -)	2	( 2)	1	( 1)
Infantis	2	( 2)	1	( 1)	2	( 3)	-	( 2)	2	( 2)
Kedougou	1	( 1)	2	( 2)	1	( 1)	-	( -)	-	( -)
Kentucky	-	( -)	1	( 1)	3	( 3)	-	( -)	1	( 1)
Kottbus	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Kubacha	-	( 3)	-	( -)	-	( -)	-	( -)	-	( -)
Livingstone	-	( -)	-	( -)	2	( 2)	-	( -)	-	( -)
Mbandaka	5	( 5)	6	( 7)	-	( 3)	-	( -)	2	( 2)
Meleagridis	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Montevideo	3	( 3)	1	( 1)	4	( 8)	3	( 4)	3	( 3)
Muenster	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Nagoya	-	( -)	-	( -)	-	( -)	1	( 1)	2	( 2)
Newington	1	( 3)	3	( 4)	-	( -)	1	( 1)	-	( -)
Newport	6	( 6)	7	( 9)	8	( 11)	7	( 9)	11	( 15)
Ohio	1	( 3)	-	( -)	-	( -)	-	( -)	-	( -)
Orion	1	( 1)	-	( -)	1	( 3)	-	( -)	-	( -)

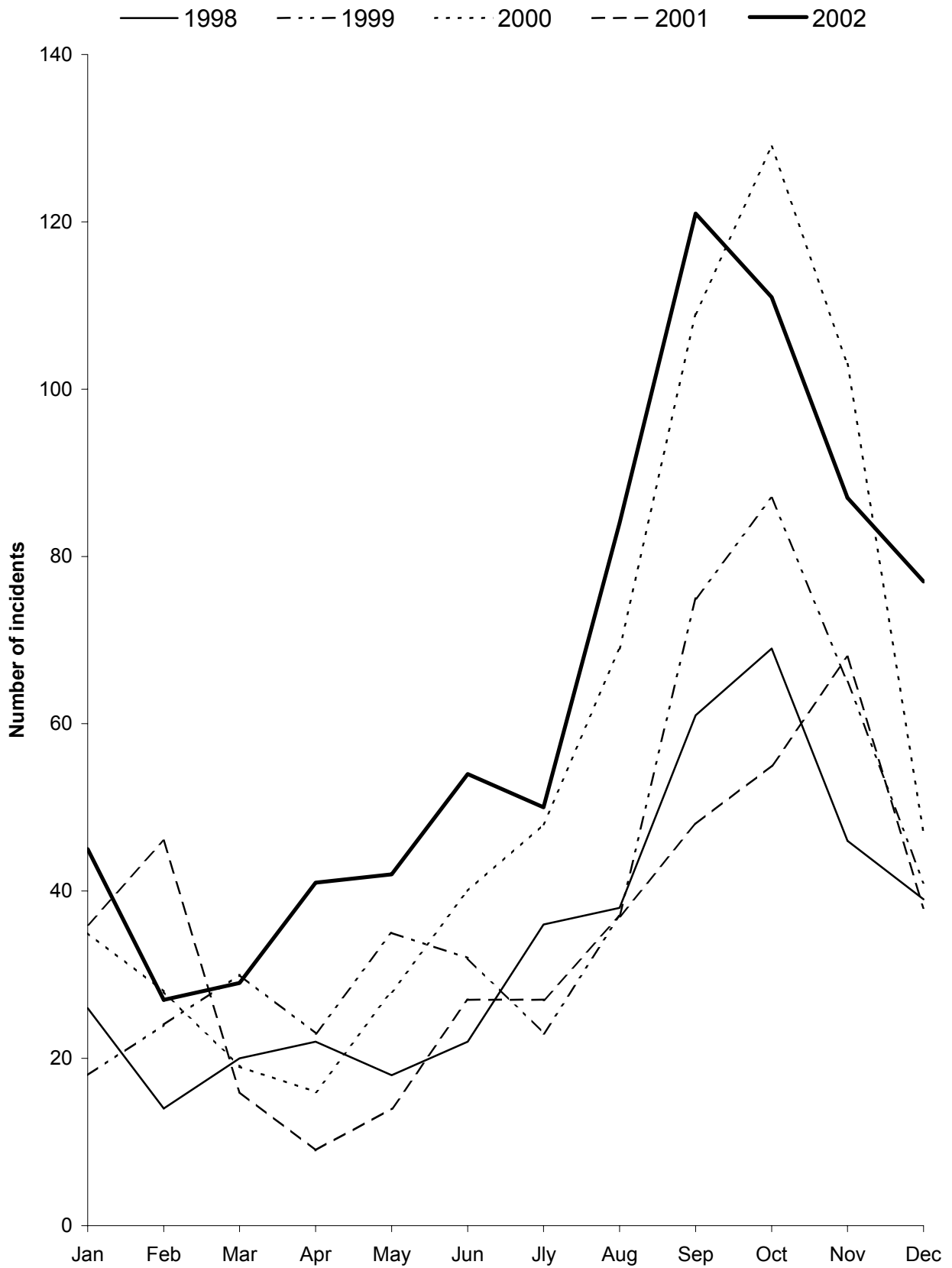
**Table 10: *Salmonella* in cattle on all premises (adults, calves & age unknown)**

<i>Salmonella</i> Incidents (Isolations)	1998		1999		2000		2001*		2002	
ENTERICA ENTERICA										
Poona	-	( -)	2	( 2)	1	( 1)	-	( -)	-	( -)
Reading	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Rubislaw	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Ruiru	-	( -)	-	( -)	1	( 2)	-	( -)	-	( -)
Saint Paul	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Schwarzengrund	2	( 2)	1	( 1)	1	( 1)	-	( -)	1	( 2)
Shubra	1	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
Stanley	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Stourbridge	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Tees	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Tennessee	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Thompson	5	( 6)	5	( 6)	2	( 2)	3	( 3)	4	( 5)
Typhimurium	489	( 715)	297	( 491)	238	( 341)	148	( 205)	140	( 188)
Vejle	-	( -)	-	( -)	-	( -)	-	( -)	4	( 8)
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)
61:-:1,5	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
61:-:1,5,7	-	( -)	-	( -)	-	( -)	1	( 1)	1	( 1)
unspecified "arizona" <sup>†</sup>	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
structure only	3	( 5)	5	( 5)	8	( 9)	3	( 3)	8	( 11)
rough strain	4	( 4)	-	( -)	1	( 1)	3	( 3)	2	( 2)
untyped	3	( 3)	1	( 2)	3	( 3)	-	( -)	3	( 4)
TOTAL	986	( 1385)	878	( 1270)	1014	( 1369)	629	( 819)	1004	( 1302)

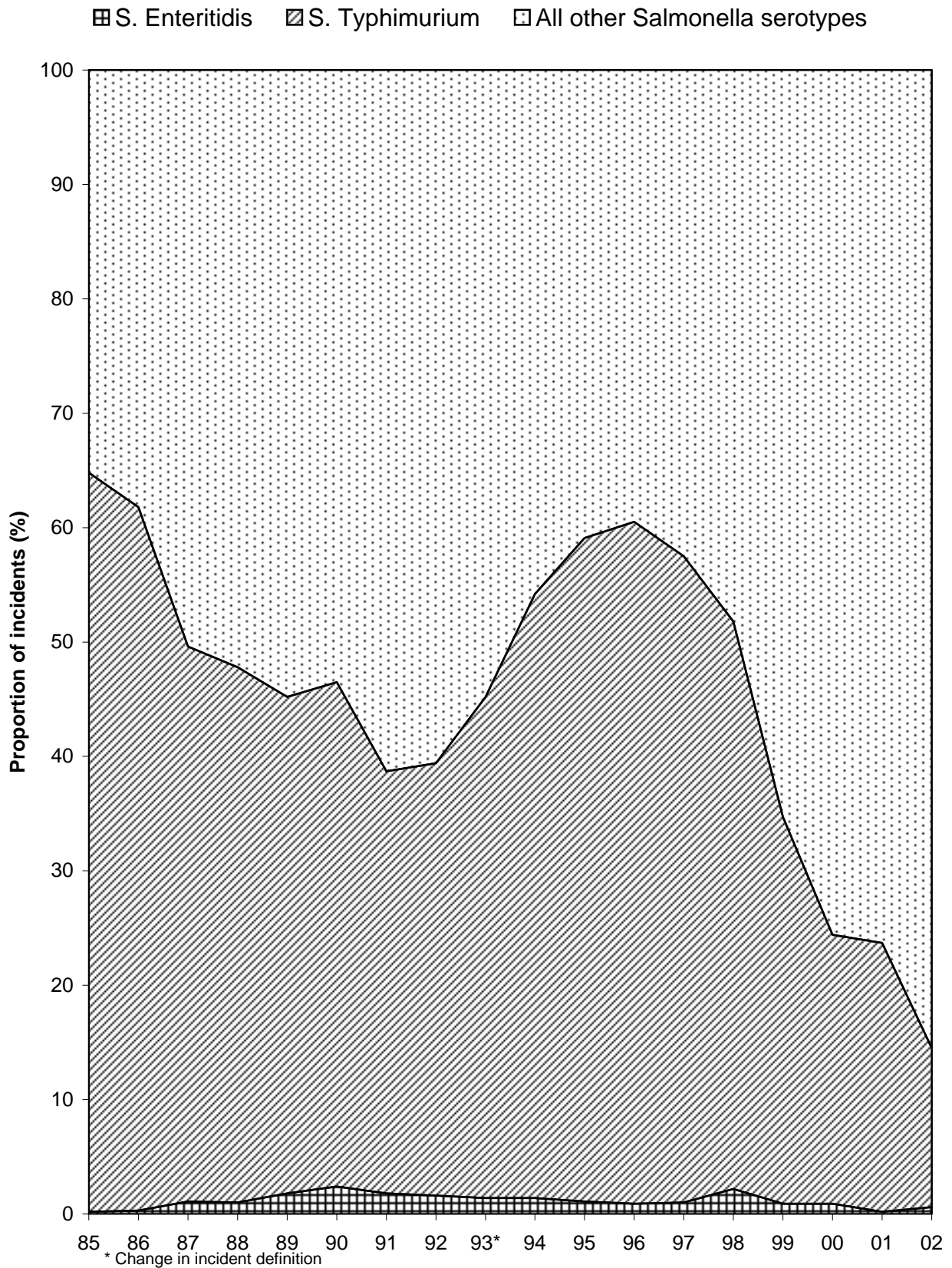
\* 2001 data may not be comparable due to impact of FMD outbreak

<sup>†</sup> antigenic structure not stated

**Fig 6: Seasonality of S. Dublin in cattle  
(1998 - 2002)**



**Fig 7 : S. Enteritidis and S. Typhimurium as a proportion of all incident reports in cattle (1985 - 2002)**



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

<i>Salmonella</i> Incidents (Isolations)	1998	1999	2000	2001*	2002
<b>ENTERICA ENTERICA</b>					
Agama	9 ( 14)	13 ( 16)	8 ( 10)	7 ( 9)	10 ( 12)
Agona	1 ( 2)	4 ( 6)	1 ( 1)	3 ( 5)	1 ( 1)
Ajiobo	- ( -)	- ( -)	1 ( 1)	- ( -)	1 ( 1)
Anatum	2 ( 3)	5 ( 6)	1 ( 1)	2 ( 2)	11 ( 20)
Ank	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Bovis morbificans	1 ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)
Binza	1 ( 1)	- ( -)	1 ( 1)	- ( -)	- ( -)
Braenderup	- ( -)	1 ( 2)	- ( -)	- ( -)	- ( -)
Brandenburg	1 ( 1)	2 ( 3)	- ( -)	- ( -)	- ( -)
Bredeney	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Derby	- ( -)	1 ( 1)	- ( -)	1 ( 1)	- ( -)
Dublin	146 ( 212)	251 ( 362)	355 ( 499)	219 ( 279)	388 ( 509)
Enteritidis	14 ( 15)	5 ( 8)	5 ( 5)	1 ( 1)	1 ( 1)
Give	- ( -)	2 ( 3)	2 ( 2)	- ( -)	1 ( 1)
Goldcoast	2 ( 3)	6 ( 9)	8 ( 9)	- ( -)	1 ( 1)
Hadar	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Heidelberg	- ( -)	1 ( 1)	1 ( 1)	1 ( 2)	- ( -)
Infantis	- ( -)	- ( -)	2 ( 3)	- ( 2)	- ( -)
Kentucky	- ( -)	1 ( 1)	2 ( 2)	- ( -)	1 ( 1)
Mbandaka	1 ( 1)	3 ( 4)	- ( 3)	- ( -)	1 ( 1)
Meleagridis	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Montevideo	1 ( 1)	- ( -)	1 ( 3)	3 ( 3)	1 ( 1)
Nagoya	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
Newington	1 ( 3)	1 ( 2)	- ( -)	1 ( 1)	- ( -)
Newport	2 ( 2)	5 ( 7)	2 ( 2)	4 ( 4)	7 ( 8)
Ohio	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Poona	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Ruiru	- ( -)	- ( -)	1 ( 2)	- ( -)	- ( -)
Saint Paul	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Schwarzengrund	- ( -)	1 ( 1)	1 ( 1)	- ( -)	1 ( 1)
Shubra	1 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
Stourbridge	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Tees	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
Tennessee	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Thompson	3 ( 3)	4 ( 5)	2 ( 2)	3 ( 3)	3 ( 4)

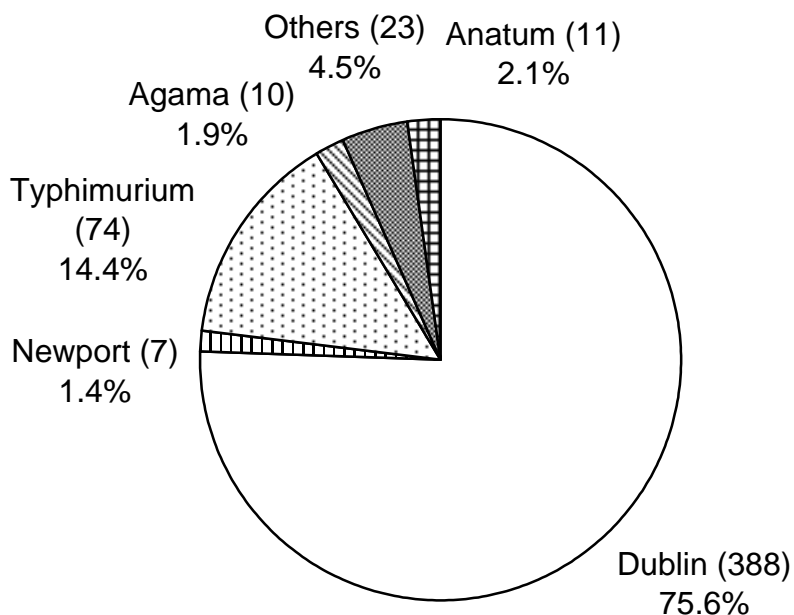
**Table 11: *Salmonella* in adult cattle on all premises**

<i>Salmonella</i> Incidents (Isolations)	1998	1999	2000	2001*	2002
ENTERICA ENTERICA					
Typhimurium	179 ( 246)	149 ( 237)	120 ( 165)	65 ( 85)	74 ( 89)
Vejle	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 4)
Virchow	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
ENTERICA DIARIZONAE					
61:k:1,5	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
61:-:1,5	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
61:-:1,5,7	- ( -)	- ( -)	- ( -)	1 ( 1)	1 ( 1)
unspecified "arizona" <sup>+</sup>	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
structure only	1 ( 2)	3 ( 3)	3 ( 3)	- ( -)	2 ( 3)
rough strain	2 ( 2)	- ( -)	- ( -)	2 ( 2)	1 ( 1)
untyped	- ( -)	- ( 1)	3 ( 3)	- ( -)	1 ( 1)
TOTAL	371 ( 517)	464 ( 685)	521 ( 720)	315 ( 402)	513 ( 655)

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

<sup>+</sup> antigenic structure not stated

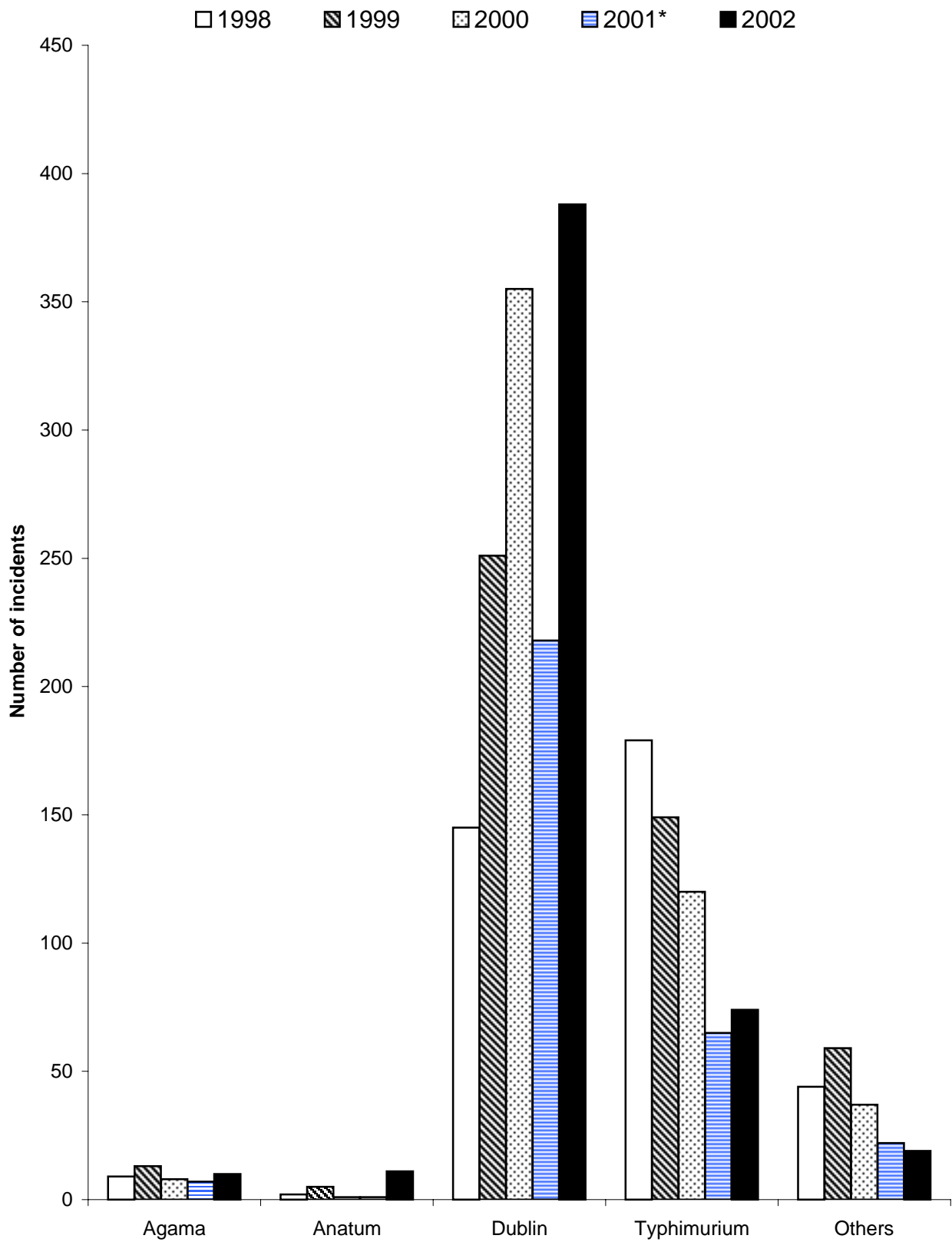
**Fig 8: Incidents of *Salmonella* serotypes in adult cattle in 2002**



**Table 12: Incidents of the top 4 *Salmonella* serotypes in adult cattle in 2002 as a % of all incidents compared to previous years**

Serotype	1998	1999	2000	2001	2002
S. Dublin %	39.4	54.1	68.1	69.5	75.6
S. Typhimurium %	48.2	32.1	23.0	20.6	14.4
S. Anatum %	0.5	1.1	0.2	0.6	2.1
S. Agama %	2.4	2.8	1.5	2.2	1.9
Total no. incidents	371	464	521	315	513

**Fig 9: Number of incidents of *Salmonella* serotypes in adult cattle (1998 - 2002)**



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

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

<i>Salmonella</i> Incidents (Isolations)	1998		1999		2000		2001*		2002	
ENTERICA ENTERICA										
Agama	4	( 4)	4	( 7)	9	( 10)	5	( 6)	2	( 5)
Agona	1	( 1)	2	( 2)	4	( 4)	1	( 1)	2	( 2)
Ajiobo	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Anatum	3	( 3)	1	( 3)	1	( 2)	-	( 1)	4	( 5)
Bovis morbificans	1	( 1)	2	( 2)	-	( -)	-	( -)	-	( -)
Binza	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Braenderup	-	( -)	-	( -)	1	( 1)	1	( 1)	-	( -)
Brandenburg	-	( -)	4	( 5)	2	( 2)	-	( -)	-	( -)
Derby	2	( 2)	1	( 1)	-	( -)	1	( 2)	-	( -)
Dublin	146	( 180)	180	( 223)	265	( 321)	150	( 183)	300	( 353)
Durham	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Enteritidis	3	( 3)	2	( 2)	2	( 2)	-	( -)	4	( 4)
Give	2	( 2)	-	( -)	2	( 2)	-	( -)	-	( -)
Goldcoast	1	( 1)	-	( -)	2	( 2)	3	( 3)	-	( -)
Havana	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
Heidelberg	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Indiana	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Infantis	1	( 1)	1	( 1)	-	( -)	-	( -)	1	( 1)
Kedougou	1	( 1)	2	( 2)	1	( 1)	-	( -)	-	( -)
Kentucky	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Kottbus	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
Livingstone	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Mbandaka	3	( 3)	3	( 3)	-	( -)	-	( -)	1	( 1)
Montevideo	1	( 1)	1	( 1)	3	( 3)	-	( -)	-	( -)
Nagoya	-	( -)	-	( -)	-	( -)	1	( 1)	1	( 1)
Newington	-	( -)	2	( 2)	-	( -)	-	( -)	-	( -)
Newport	1	( 1)	1	( 1)	2	( 4)	2	( 2)	2	( 2)
Orion	-	( -)	-	( -)	1	( 3)	-	( -)	-	( -)
Poona	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
Reading	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
Schwarzengrund	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
Thompson	1	( 1)	1	( 1)	-	( -)	-	( -)	1	( 1)
Typhimurium	169	( 211)	125	( 183)	86	( 109)	47	( 60)	45	( 56)

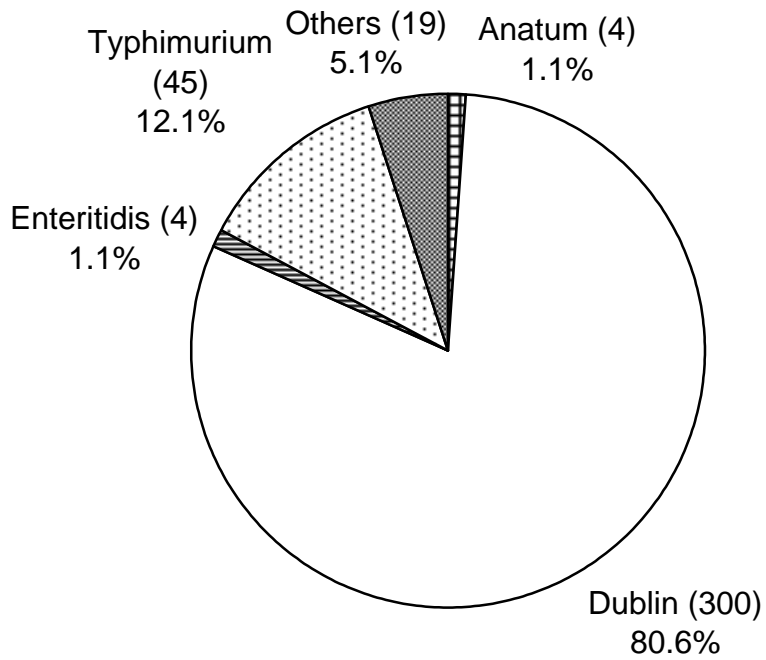
**Table 13: *Salmonella* in calves on all premises**

<i>Salmonella</i> Incidents (Isolations)	1998	1999	2000	2001*	2002
ENTERICA ENTERICA					
Virchow	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
ENTERICA DIARIZONAE					
61:k:1,5	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
61:k:1,5,7	- ( -)	- ( -)	2 ( 2)	- ( -)	- ( -)
structure only	1 ( 1)	2 ( 2)	2 ( 3)	2 ( 2)	5 ( 7)
rough strain	- ( -)	- ( -)	1 ( 1)	1 ( 1)	1 ( 1)
untyped	2 ( 2)	1 ( 1)	- ( -)	- ( -)	1 ( 1)
TOTAL	346 ( 422)	339 ( 446)	389 ( 475)	216 ( 265)	372 ( 442)

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

+ antigenic structure not stated

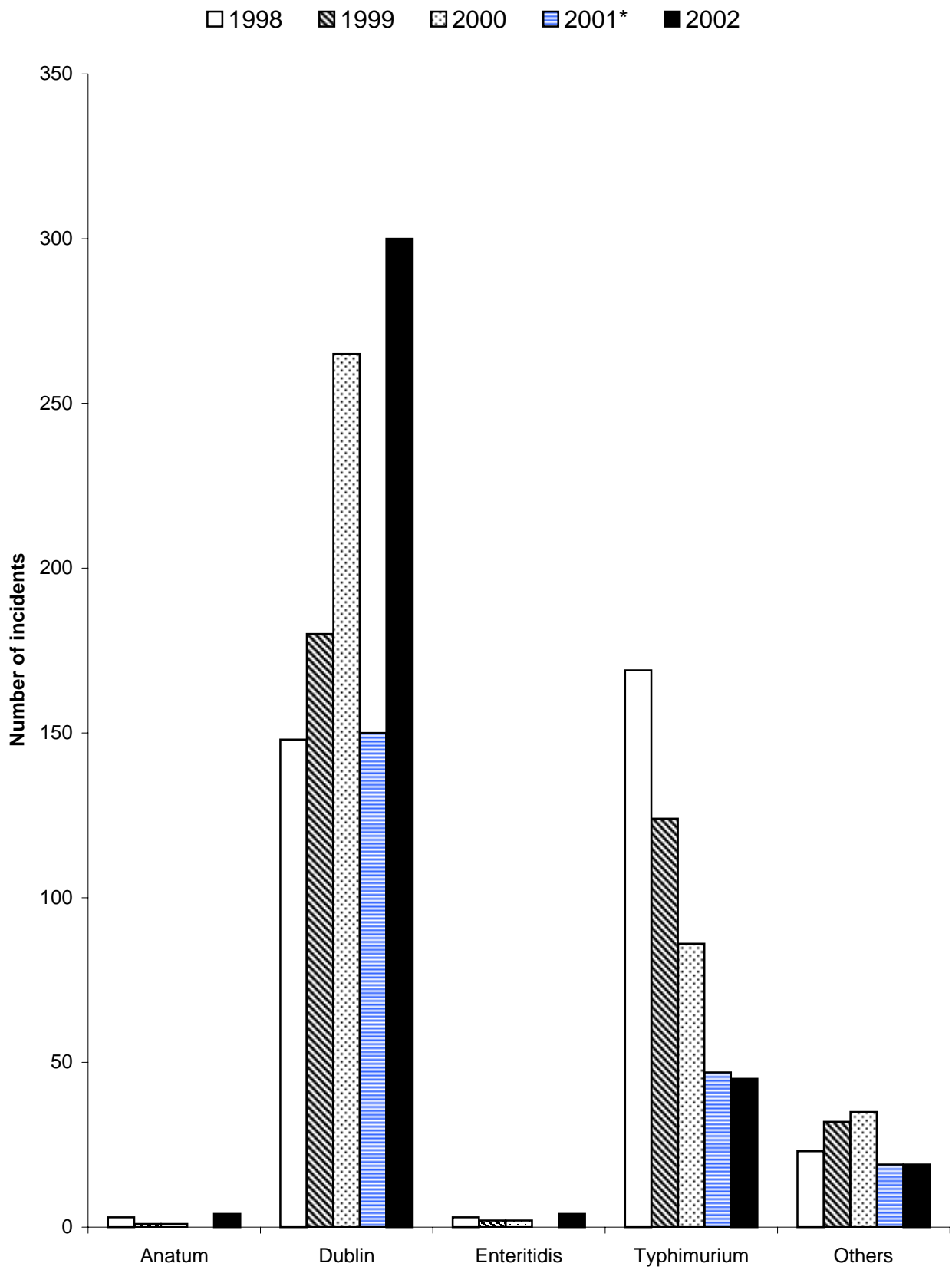
**Fig 10: Incidents of *Salmonella* serotypes in calves in 2002**



**Table 14: Incidents of the top 4 *Salmonella* serotypes in calves in 2002 as a % of all incidents compared to previous years**

Serotype	1998	1999	2000	2001	2002
S. Dublin %	42.2	53.1	68.1	69.4	80.6
S. Typhimurium %	48.8	36.9	22.1	21.8	12.1
S. Anatum %	0.9	0.3	0.3	0	1.1
S. Enteritidis %	0.9	0.6	0.5	0	1.1
Total no. incidents	346	339	389	216	372

**Fig 11: Number of incidents of *Salmonella* serotypes in calves (1998 - 2002)**



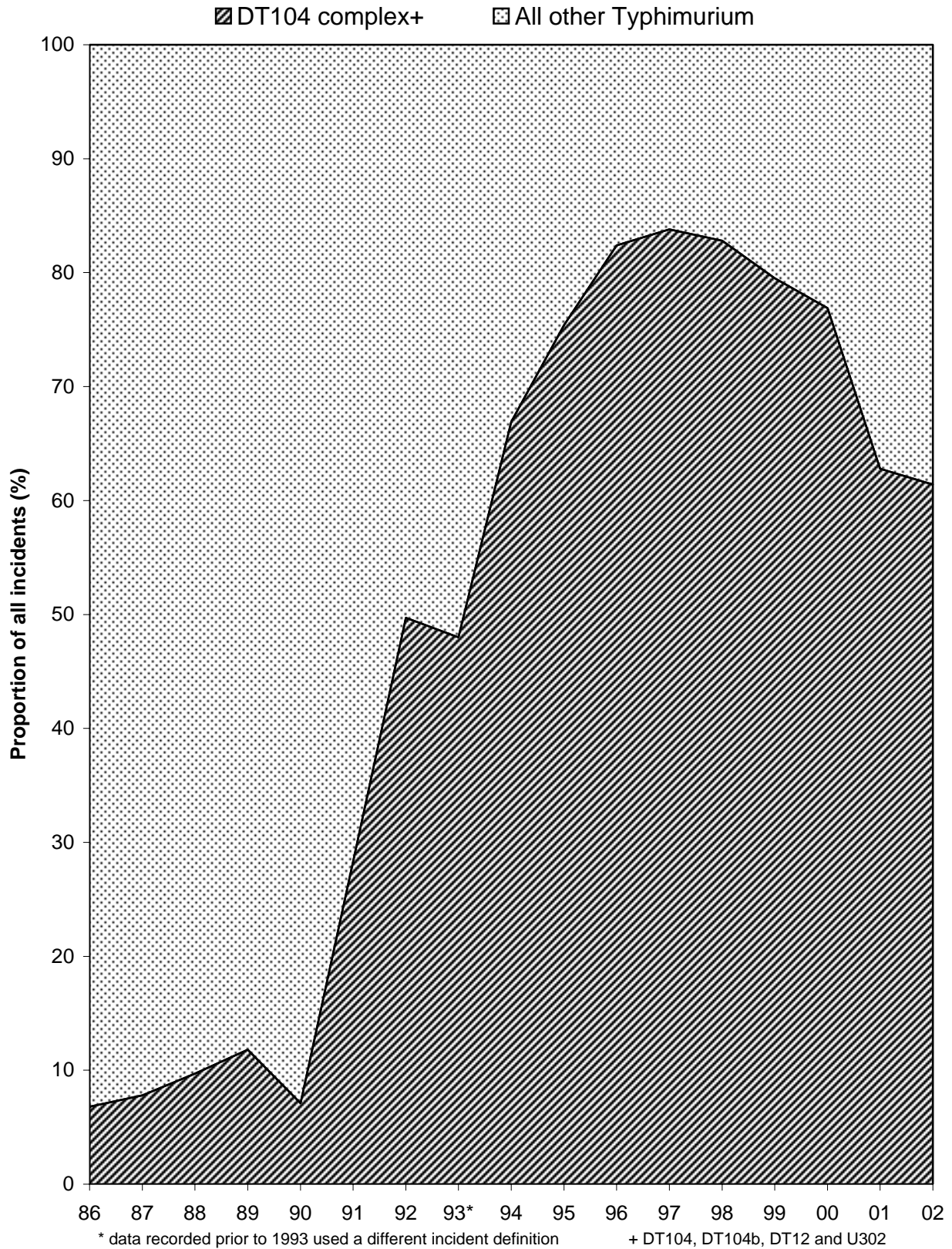
\* 2001 data may not be comparable due to uncertain impact of FMD outbreak

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

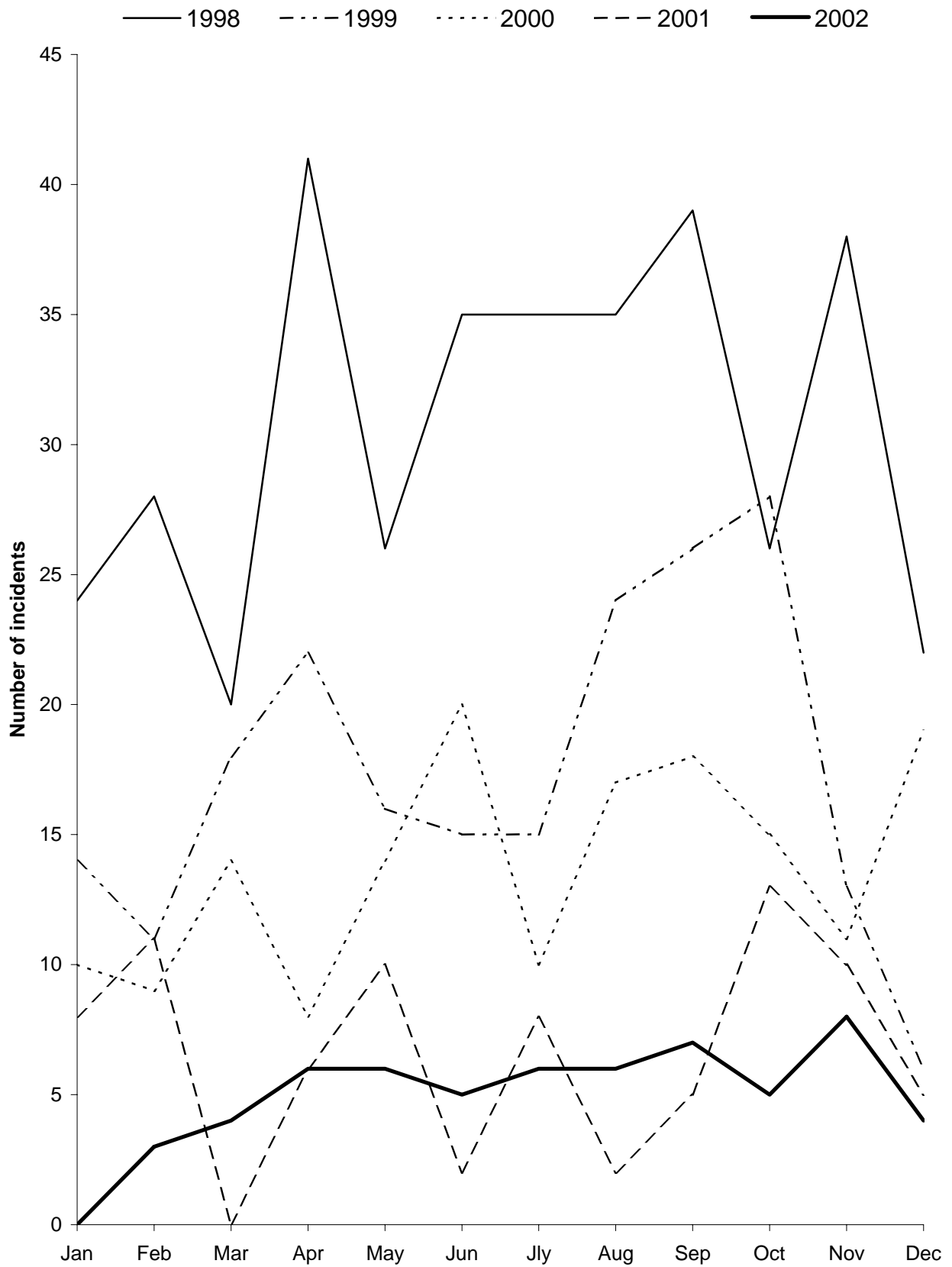
Definitive Types Incidents (Isolations)	1998		1999		2000		2001*		2002	
1	2	( 2)	-	( -)	-	( -)	-	( -)	-	( -)
2	-	( -)	-	( -)	-	( -)	-	( -)	1	( 1)
8	-	( -)	1	( 1)	-	( -)	1	( 1)	-	( -)
12	11	( 14)	7	( 9)	-	( -)	2	( 2)	6	( 8)
17	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
35	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
40	1	( 1)	-	( -)	1	( 1)	1	( 1)	2	( 2)
41	1	( 1)	3	( 3)	1	( 2)	1	( 1)	1	( 1)
49	1	( 3)	-	( -)	1	( 1)	-	( -)	-	( -)
49b	-	( -)	1	( 1)	-	( -)	-	( -)	-	( -)
56	1	( 1)	-	( -)	-	( -)	-	( -)	2	( 2)
67	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
69	-	( -)	-	( -)	-	( -)	2	( 3)	-	( -)
99	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
103	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
104	367	( 555)	208	( 366)	164	( 244)	80	( 118)	60	( 89)
104b	22	( 31)	9	( 9)	4	( 6)	5	( 7)	5	( 10)
104c	-	( -)	-	( -)	1	( 1)	-	( -)	-	( -)
108	-	( -)	1	( 1)	1	( 1)	-	( -)	-	( -)
110	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
120	2	( 2)	5	( 6)	7	( 7)	6	( 6)	4	( 4)
135	2	( 2)	3	( 3)	-	( -)	-	( -)	-	( -)
141	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
170	-	( -)	-	( -)	5	( 5)	3	( 5)	6	( 7)
193	17	( 27)	12	( 15)	11	( 17)	6	( 10)	3	( 6)
193a	-	( -)	-	( -)	-	( -)	-	( -)	2	( 3)
195	1	( 1)	1	( 1)	-	( -)	-	( -)	-	( -)
204	1	( 1)	-	( -)	-	( -)	-	( -)	-	( -)
208	2	( 3)	-	( -)	1	( 1)	3	( 6)	5	( 6)
U302	5	( 6)	14	( 35)	14	( 21)	6	( 9)	15	( 19)
U308a	-	( -)	-	( -)	-	( -)	2	( 2)	-	( -)
U310	-	( -)	-	( -)	-	( -)	1	( 1)	-	( -)
RDNC	5	( 5)	-	( -)	1	( 1)	3	( 3)	10	( 11)
NOPT	9	( 10)	10	( 14)	1	( 1)	1	( 1)	-	( -)
UNTY	34	( 45)	22	( 27)	22	( 29)	20	( 23)	9	( 9)
Untyped	2	( 2)	-	( -)	-	( -)	4	( 5)	9	( 10)
TOTAL	489	( 715)	297	( 491)	238	( 341)	148	( 205)	140	( 188)

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

**Fig 12: *Salmonella* Typhimurium DT104 and related strains as a proportion of all reports of *Salmonella* Typhimurium in cattle 1986 - 2002**



**Fig 13: Seasonality of *S. Typhimurium* DT104 in cattle  
(1998 - 2002)**

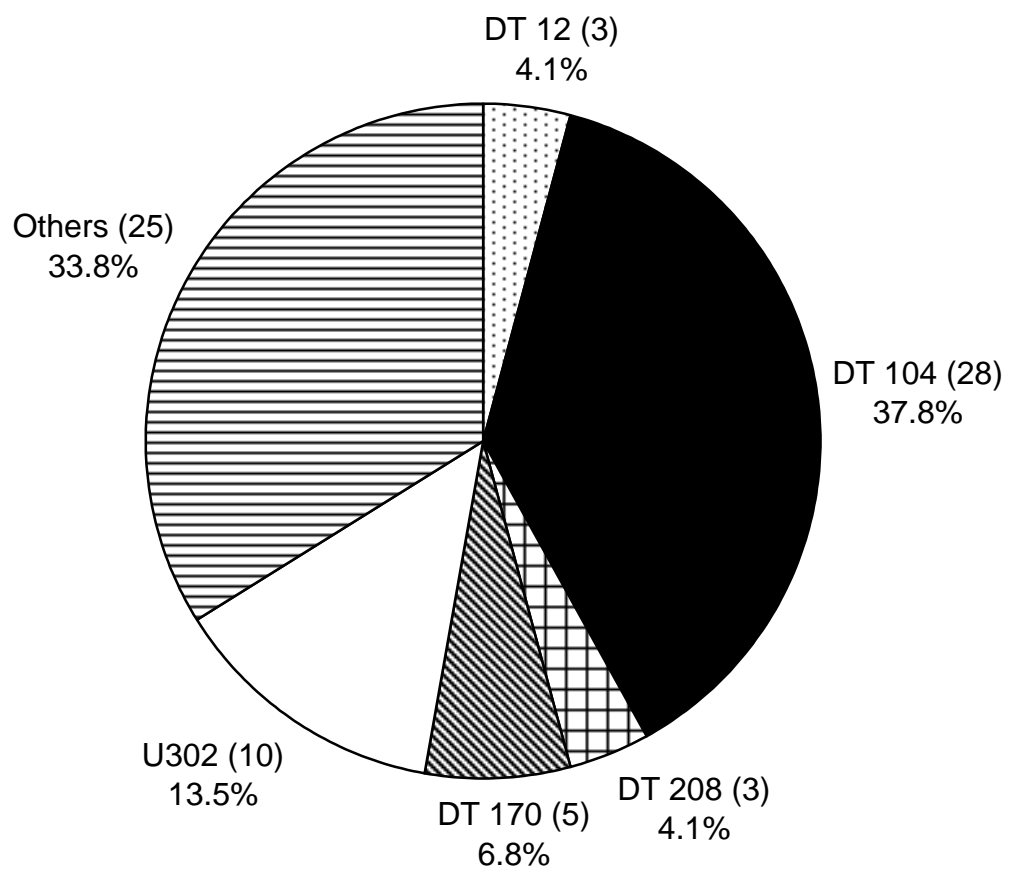


**Table 16: S.Typhimurium in adult cattle on all premises**

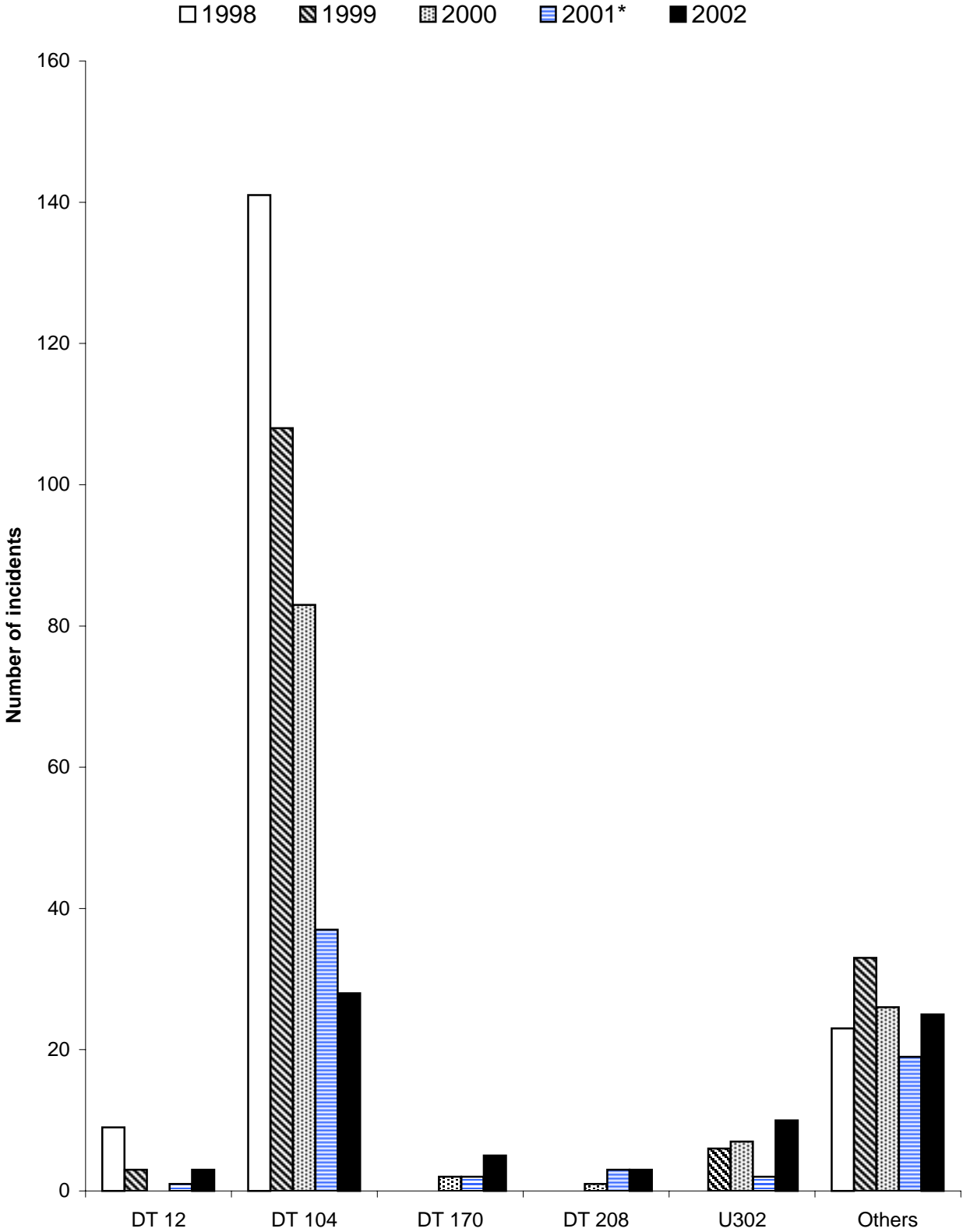
Definitive Types Incidents (Isolations)	1998	1999	2000	2001*	2002
1	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
8	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
12	9 (11)	3 ( 5)	- ( -)	1 ( 1)	3 ( 4)
40	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
41	1 ( 1)	2 ( 2)	- ( -)	1 ( 1)	1 ( 1)
49	1 ( 3)	- ( -)	- ( -)	- ( -)	- ( -)
49b	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
67	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
69	- ( -)	- ( -)	- ( -)	1 ( 2)	- ( -)
99	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
104	141 (199)	108 (177)	82 (117)	37 ( 48)	28 ( 38)
104b	9 ( 10)	5 ( 5)	1 ( 1)	2 ( 2)	2 ( 3)
104c	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
108	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
120	- ( -)	1 ( 1)	2 ( 2)	1 ( 1)	2 ( 2)
135	- ( -)	2 ( 2)	- ( -)	- ( -)	- ( -)
170	- ( -)	- ( -)	3 ( 3)	2 ( 4)	5 ( 5)
193	6 ( 9)	6 ( 7)	8 (11)	3 ( 4)	1 ( 1)
193a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 2)
195	1 ( 1)	1 ( 1)	- ( -)	- ( -)	- ( -)
208	- ( -)	- ( -)	1 ( 1)	3 ( 4)	3 ( 4)
U302	- ( -)	6 ( 19)	7 ( 9)	2 ( 3)	10 ( 11)
U308a	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
RDNC	1 ( 1)	- ( -)	1 ( 1)	1 ( 1)	7 ( 7)
NOPT	1 ( 1)	4 ( 5)	- ( -)	- ( -)	- ( -)
UNTY	8 ( 9)	10 (11)	11 (16)	9 (11)	5 ( 5)
Untyped	- ( -)	- ( -)	- ( -)	1 ( 2)	4 ( 4)
<b>TOTAL</b>	<b>179 (246)</b>	<b>150 (237)</b>	<b>120 (165)</b>	<b>65 ( 85)</b>	<b>74 ( 89)</b>

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

**Fig 14: Incidents of Salmonella Typhimurium definitive types in adult cattle in 2002**



**Fig 15: Incidents of *Salmonella* Typhimurium definitive types in adult cattle (1998 - 2002)**



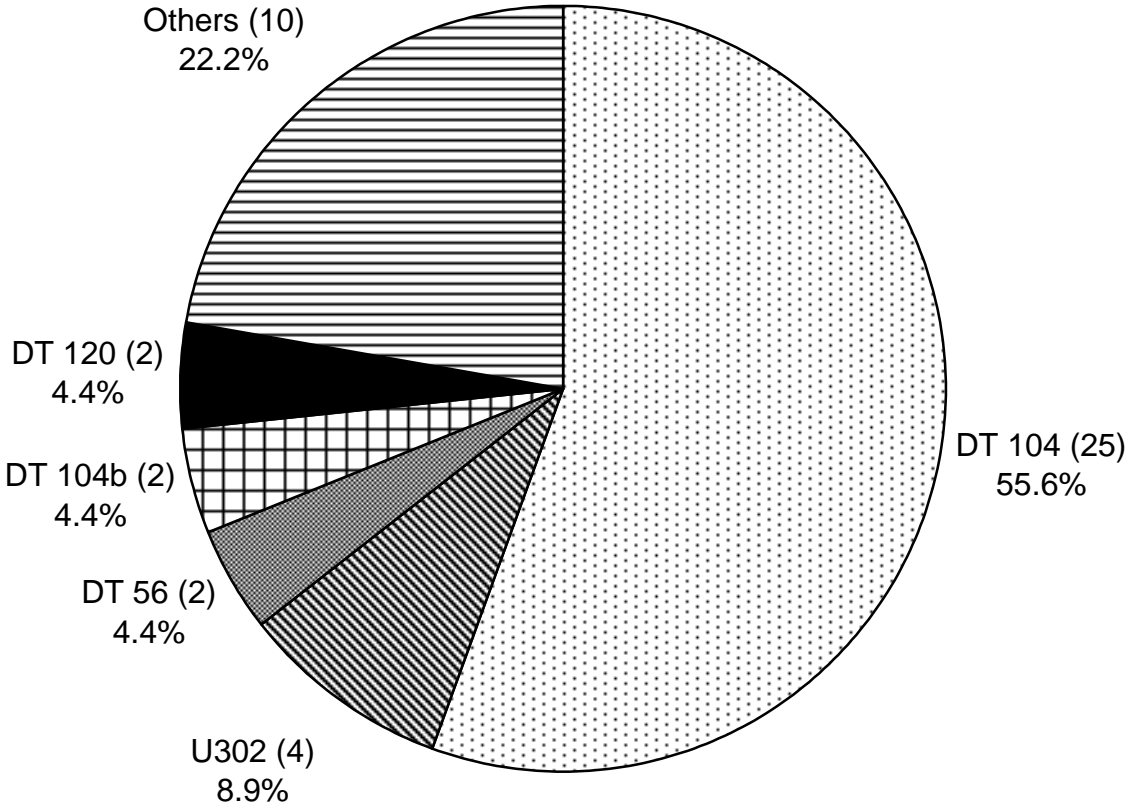
\* 2001 data may not be comparable due to uncertain impact of FMD outbreak

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

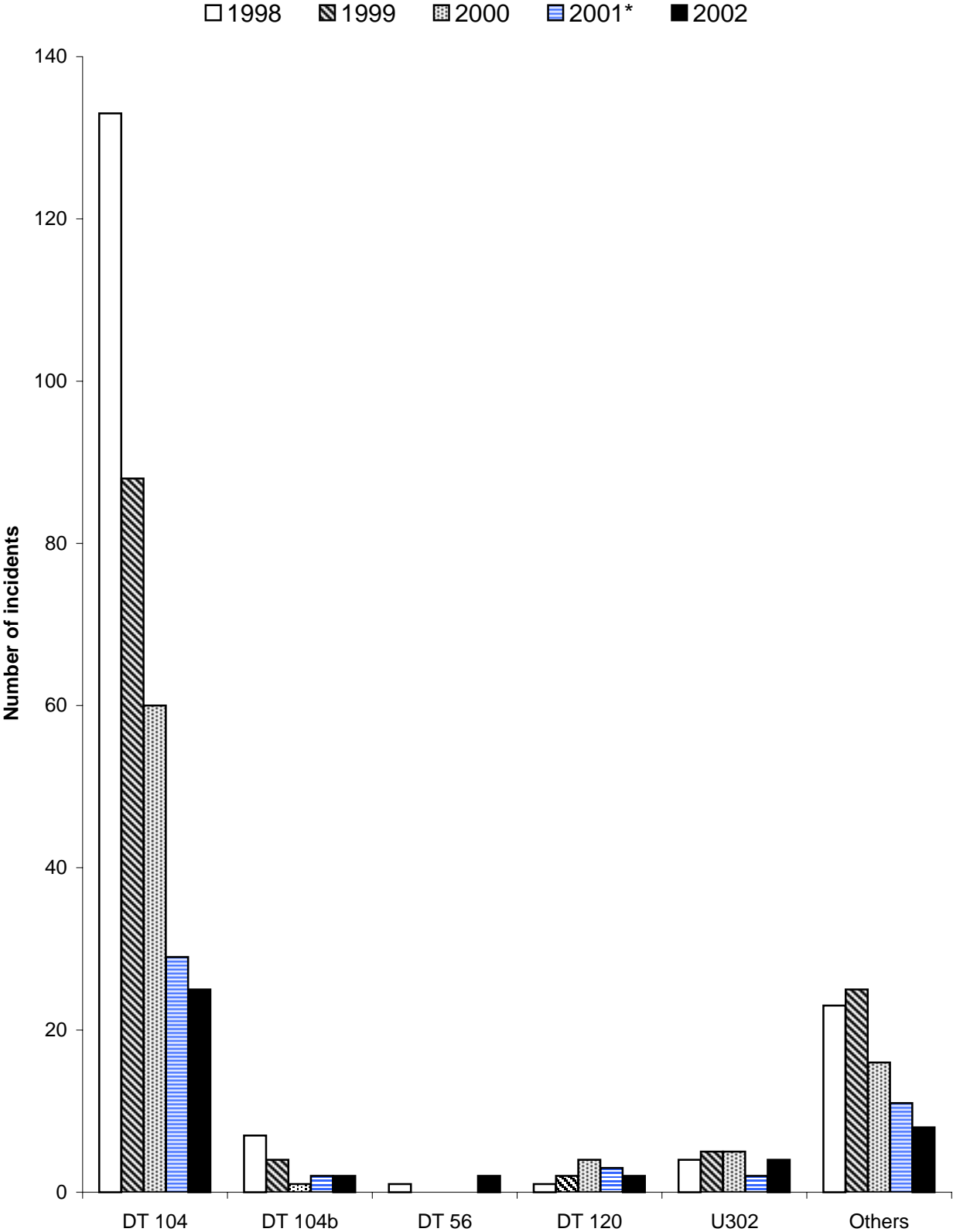
Definitive Types Incidents (Isolations)	1998	1999	2000	2001*	2002
8	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
12	2 ( 3)	4 ( 4)	- ( -)	- ( -)	1 ( 2)
17	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
40	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
41	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
56	1 ( 1)	- ( -)	- ( -)	- ( -)	2 ( 2)
69	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
103	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
104	133 ( 168)	88 ( 138)	60 ( 80)	29 ( 39)	25 ( 32)
104b	7 ( 11)	4 ( 4)	1 ( 1)	2 ( 3)	2 ( 4)
108	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
110	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
120	1 ( 1)	2 ( 3)	4 ( 4)	3 ( 3)	2 ( 2)
135	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
170	- ( -)	- ( -)	1 ( 1)	1 ( 1)	- ( 1)
193	6 ( 6)	6 ( 7)	3 ( 3)	1 ( 1)	1 ( 1)
193a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
204	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
208	- ( -)	- ( -)	- ( -)	- ( 1)	1 ( 1)
U302	4 ( 5)	5 ( 9)	5 ( 7)	2 ( 3)	4 ( 4)
U308a	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
U310	- ( -)	- ( -)	- ( -)	1 ( 1)	- ( -)
RDNC	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
NOPT	- ( -)	2 ( 3)	1 ( 1)	- ( -)	- ( -)
UNTY	11 ( 12)	11 ( 13)	8 ( 9)	2 ( 2)	3 ( 3)
Untyped	2 ( 2)	- ( -)	- ( -)	2 ( 2)	1 ( 1)
<b>TOTAL</b>	<b>169 ( 211)</b>	<b>124 ( 183)</b>	<b>86 ( 109)</b>	<b>47 ( 60)</b>	<b>45 ( 56)</b>

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

**Fig 16: Incidents of *Salmonella* Typhimurium definitive types in calves in 2002**



**Fig 17: Incidents of *Salmonella* Typhimurium definitive types in calves (1998 - 2002)**



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

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
1	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
4	14 ( 17)	6 ( 7)	3 ( 3)	1 ( 1)	2 ( 2)
5	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
6	1 ( 1)	1 ( 3)	- ( -)	- ( -)	2 ( 2)
6a	1 ( 1)	- ( -)	- ( -)	- ( -)	1 ( 1)
7	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
8	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
9a	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
11	- ( -)	1 ( 1)	1 ( 1)	- ( -)	- ( -)
13a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
21	2 ( 2)	- ( -)	1 ( 1)	- ( -)	- ( -)
24	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
RDNC	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
Untyped	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
<b>TOTAL</b>	<b>22 ( 25)</b>	<b>8 ( 11)</b>	<b>9 ( 9)</b>	<b>1 ( 1)</b>	<b>6 ( 6)</b>

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

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
1	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
4	9 ( 10)	4 ( 5)	2 ( 2)	1 ( 1)	1 ( 1)
5	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
6	1 ( 1)	1 ( 3)	- ( -)	- ( -)	- ( -)
7	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
21	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
24	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
Untyped	1 ( 1)	- ( -)	- ( -)	- ( -)	- ( -)
<b>TOTAL</b>	<b>14 ( 15)</b>	<b>5 ( 8)</b>	<b>5 ( 5)</b>	<b>1 ( 1)</b>	<b>1 ( 1)</b>

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
4	2 ( 2)	1 ( 1)	- ( -)	- ( -)	- ( -)
6	- ( -)	- ( -)	- ( -)	- ( -)	2 ( 2)
6a	1 ( 1)	- ( -)	- ( -)	- ( -)	1 ( 1)
9a	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
11	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
13a	- ( -)	- ( -)	- ( -)	- ( -)	1 ( 1)
21	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
<b>TOTAL</b>	<b>3 ( 3)</b>	<b>2 ( 2)</b>	<b>2 ( 2)</b>	<b>- ( -)</b>	<b>4 ( 4)</b>

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

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
NOPT	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
Totals	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
1	- ( -)	2 ( 2)	- ( -)	- ( -)	- ( -)
1a	- ( -)	1 ( 1)	- ( -)	- ( -)	- ( -)
6	2 ( 2)	- ( -)	- ( -)	- ( -)	- ( -)
23	- ( -)	- ( -)	1 ( 1)	2 ( 2)	- ( -)
RDNC	- ( -)	- ( -)	1 ( 1)	- ( -)	- ( -)
NOPT	3 ( 4)	2 ( 3)	- ( -)	1 ( 1)	4 ( 5)
TOTAL	5 ( 6)	5 ( 6)	2 ( 2)	3 ( 3)	4 ( 5)

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

Phage Types Incidents (Isolations)	1998	1999	2000	2001*	2002
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 outbreak