

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 8.9 million cattle in Great Britain in 2004, 0.8% more than in 2003 and 2.8% more than in 2002. Over half a million adult cattle were slaughtered during the FMD epidemic in 2001. 798,617 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 2004. 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* transmissions between premises in recent years, if sustained.

Over the past eight years there has been a 42% decrease in the number of diagnostic submissions from cattle reported to the VIDA database. The number of diagnostic submissions in 2004 decreased to 38,509, a 15% decrease compared to 2003, reversing the increases seen in 2002 and 2003. In 2001 there were fewer diagnostic submissions (31,280) due to the FMD epidemic (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. As in previous years, the majority (96%) of *Salmonella* reports (n=978) in cattle were from samples taken from clinical diagnostic purposes (see Table 1, Chapter 1) and came from animals on farms.

There were 16% less *Salmonella* incidents in cattle reported in 2004 (1067) as compared to 2003 (1268), probably due to decrease in diagnostic submission numbers. Some serovars were reported in cattle in 2004 for the first time in the last five years including *S. Bradford*, *S. Kiambu*, *S. Larochelle*, *S. Liverpool* and *S. London*. *Salmonella* *Kimuenza*, *S. Kottbus* and *S. Stanley* were reported in adult cattle for the first time in the last five years. *Salmonella* *Poona* and *S. Vejle* were reported in calves for the first time in the last five years. New *Salmonella* serotypes reported in 2004, as compared to 2003 were *S. Binza*, *S. Bovis morbificans*, *S. Give*, *S. Mbandaka*, *S. Reading* and *S. Schwarzengrud*. *Salmonella* serotypes that have not been reported in the last five years include *S. Meleagridis*, *S. Muenster*, *S. St Paul* and *S. Tennessee*. Of the 1067 incidents in cattle, 42% were in adult cattle, 37% in calves and 21% in cattle of unknown age. For the sixth year, *S. Dublin* was the most common (73% of incidents) serovar reported in cattle and was also the third most common *Salmonella* reported in sheep (see Chapter 2.2).

The results of a Great Britain wide abattoir survey for foodborne pathogens carried out during 2003 were reported. *Salmonella* was cultured from the caecal contents of 1.4% of cattle (see Chapter 3). This is higher than the previous survey in 1999/2000 when *Salmonella* was cultured from 0.2% of cattle.

***Salmonella* Dublin**

For the sixth consecutive year, *S. Dublin* was the most common serotype in adult cattle (64% of incidents; Figure 8) and calves (85% of incidents; Figure 10). The relative proportion of *S. Dublin* in adult cattle decreased (from 73 to 64%), while the relative proportion of *S. Typhimurium* increased (from 13 to 16%) in 2004 compared to 2003 (Table 12). In contrast, the relative proportion of *S. Dublin* in calves increased slightly (from 84% to 85%), while the relative proportion of *S. Typhimurium* decreased (from 9% to 7.5%) in 2004 compared to 2003 (Table 14). There appeared to be regional differences in reports, with the majority of incidents of *S. Dublin* being reported in North West England, whilst in 2004 the number of incidents reported from Scotland and Wales were approximately the same. There continues to be a seasonal increase in the number of incidents

during September to November, although the usual peak in October was not seen in 2004 (see Figure 6). *S. Dublin* was the third most common infectious cause of bovine foetopathy in GB (9% of diagnosed submissions; VIDA 2004). *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. *Salmonella* Dublin as a cause of bacteraemia and septicaemia was isolated from joint fluid, spleen and liver submitted from field post mortem examination of a three-week old calf. Calves over five days old showed symptoms of pyrexia and panting. After antibiotic treatment, some recovered well, but others showed signs of septic arthritis and cellulitis over the hooves. In another unusual case, a three-week old Simmental cross calf was submitted, following heavy breathing, collapse and death. Post-mortem examination revealed enlarged liver with fibrotic, markedly thickened capsule and enlarged bronchial lymph nodes. *Salmonella* Dublin was isolated in pure culture from the liver, spleen and lung.

***Salmonella* Typhimurium**

There is a decline in the number of reports of *S. Typhimurium* in cattle in the last five years (Table 10), which continues to be the second most common *Salmonella* serotype reported from cattle in 2004 with 140 incidents reported (Table 10). The proportion of *Salmonella* incidents in adult cattle due this serovar, which was steadily declining up to 2003, showed a small increase in 2004 (16%), but has declined further in calves to 7.5% (Tables 12 and 14). There were no new *S. Typhimurium* definitive types reported from cattle in 2004. The definitive types DT166, DT169, U288 and U311 reported in 2003 for the first time in the last five years were not reported again in 2004. Cases due to *S. Typhimurium* U310, previously linked predominantly with pigs, remained low but increased (nine incidents reported in 2004, while six incidents were reported in 2003). Reports of *Salmonella* Typhimurium DT104 appear to fluctuate during the year with a first peak noted in May and June and a second, higher peak in September (see Figure 13). DT104 remains the most common definitive type (54% of incidents) and is usually found in dairy cattle. Incidents reported due to *S. Typhimurium* DT104 declined by 28% in 2004 compared to 2003. Forty-six per cent of incidents were due to non-DT104 phage types, although 16% were strains related to DT104 (DT104b, DT12, U302)

Other serovars

Salmonella Enteritidis, *S. Hadar*, *S. Thompson* and *S. Virchow* are phage typed routinely. There were four reported incidents of *S. Enteritidis* (Table 18). These comprised two incidents of PT1 and one incident of PT4 in adult cattle and one incident of PT13a in a calf (see Tables 19 and 20). There were no incidents of new *S. Enteritidis* phage types reported in 2004. There were no incidents of *S. Hadar* or *S. Virchow* reported in 2004 (see Tables 21 and 23), while there were two reports of *S. Thompson* (both PT1), (see Table 22). The increase in number of incidents of *S. Anatum* in 2003 was sustained, particularly in adult cattle (4.9% of incidents; Table 12). This serovar was isolated from a culture taken from a freshly calved cow showing signs of pyrexia and retained fetal membranes. The outbreak was investigated and environmental sampling showed widespread group E *Salmonella* contamination. Wild birds were thought to be the likely source as a group E *Salmonella* was also isolated from birds droppings. Other potential sources of infection included visiting rooks from neighbouring pig fields, as well as indirect contamination of dry cow grazing with drainage water from pigs.

Salmonella Bradford, *Salmonella* Larochelle and *Salmonella* Liverpool had never been previously isolated from cattle during routine surveillance in Great Britain but one incident of each serotype was reported for the first time in adult cattle in 2004. One incident of *Salmonella* Kiambu was reported, in a bovine animal of unknown age, for the first time through routine surveillance in Great Britain. There were five incidents of *S. London*, which was reported for the first time in cattle in recent years. Two incidents were from adult cattle, one from a calf and two from cattle of unknown age. The last time *Salmonella* London was reported in cattle through routine surveillance was in 1994. *Salmonella* Kimuenza was reported for the first time in adult cattle in the last five years. The incident involved a case of post calving dysentery in a dairy herd. *Salmonella* Binza had never been isolated from cattle during routine surveillance until 2000, and three further incidents were reported in 2004. *Salmonella* Schwarzengrund had never been reported from cattle until 2002 and was also responsible for six incidents in 2004. Reports of *Salmonella* Vejle in cattle increased in 2004 (eight incidents) compared to 2003 (four incidents). This serovar was first reported in cattle in 2002, while it 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 six incidents of *Salmonella* Newport reported in cattle (five in adult cattle and one in a calf), representing 1.1% of incidents in adult cattle and 0.25% of incidents in calves; all were fully susceptible to all antimicrobials tested. *Salmonella* Newport was isolated during an outbreak investigation of abortion, milk drop and dysentery in a 120-cow milk herd, with six cows affected and one that died. No multiple drug resistance

evidence was found. The multiple drug resistant *Salmonella* Newport (MDRSN) has not yet been reported in Great Britain, 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 eight 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). 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 in England and Wales 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, 2005). 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, eight to ten one-week old calves were clinically affected with a dark scour, and five or six 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). An epidemiological investigation of the calf rearing premises and a closely associated dairy herd was carried out. The organism was widespread on the calf unit and was also recovered from the dairy premises, mainly from groups of weaned calves. The investigation was extended to 10 epidemiologically linked farms, but no *S. Java* was isolated from any of the samples collected from those premises. Molecular studies showed that the *S. Java* isolates were genetically more similar to isolates from cases of human disease associated with ornamental fish tanks or feed. Long PCR and resistance gene profiling identified a resistance island indistinguishable from the human "fish tank" strain of *S. Java* and animal and human epidemic strains of *S. Typhimurium* DT104. 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, but these isolates were found to be clearly distinguishable from multi-resistant *S. Java* strains commonly associated with continental poultry. This was 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 were no further reports of *S. Java* in 2004.

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

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Agama	20 (25)	13 (17)	13 (19)	15 (16)	16 (16)
Agona	5 (5)	4 (7)	4 (4)	4 (4)	6 (6)
Ajiobo	1 (1)	- (-)	2 (2)	1 (1)	2 (2)
Anatum	3 (5)	3 (4)	15 (26)	39 (40)	31 (34)
Ank	- (-)	- (-)	1 (1)	- (-)	- (-)
Binza	2 (2)	- (-)	- (-)	- (-)	3 (3)
Bovis morbificans	- (-)	1 (1)	- (-)	- (-)	1 (1)
Bradford	- (-)	- (-)	- (-)	- (-)	1 (1)
Braenderup	1 (1)	1 (1)	- (-)	- (-)	- (-)
Brandenburg	4 (4)	1 (1)	- (-)	- (-)	- (-)
Bredeney	- (-)	- (-)	1 (1)	- (-)	- (-)
Derby	- (-)	2 (3)	- (-)	2 (2)	2 (2)
Dublin	671 (899)	421 (539)	768 (985)	962 (1160)	780 (795)
Durham	- (-)	1 (1)	- (-)	1 (1)	- (-)
Enteritidis	9 (9)	1 (1)	6 (6)	13 (14)	4 (7)
Give	4 (4)	1 (1)	1 (1)	- (-)	2 (2)
Goldcoast	11 (13)	4 (4)	3 (5)	8 (8)	4 (4)
Hadar	- (-)	- (-)	- (-)	1 (1)	- (-)
Havana	- (-)	1 (1)	- (-)	1 (1)	- (-)
Heidelberg	2 (2)	1 (2)	1 (1)	- (-)	- (-)
Indiana	- (-)	2 (2)	1 (1)	- (-)	- (-)
Infantis	2 (3)	- (2)	2 (2)	1 (1)	1 (1)
Kedougou	1 (1)	- (-)	- (-)	12 (12)	5 (5)
Kentucky	3 (3)	- (-)	1 (1)	- (-)	- (-)
Kiambu	- (-)	- (-)	- (-)	- (-)	1 (1)
Kimuenza	- (-)	- (-)	- (-)	3 (4)	1 (1)
Kottbus	- (-)	- (-)	1 (1)	1 (1)	1 (1)
Larochelle	- (-)	- (-)	- (-)	- (-)	1 (1)
Liverpool	- (-)	- (-)	- (-)	- (-)	1 (1)
Livingstone	2 (2)	- (-)	- (-)	- (-)	- (-)
London	- (-)	- (-)	- (-)	- (-)	5 (6)
Mbandaka	- (3)	- (-)	2 (2)	(-) (-)	2 (2)
Montevideo	4 (8)	3 (4)	3 (3)	7 (7)	17 (17)
Nagoya	- (-)	1 (1)	2 (2)	1 (1)	(-) (-)
Newington	- (-)	1 (1)	- (-)	(-) (-)	(-) (-)
Newport	8 (11)	7 (9)	11 (15)	7 (7)	6 (7)
Orion	1 (3)	- (-)	- (-)	- (-)	- (-)
Oslo	- (-)	- (-)	- (-)	5 (5)	- (-)

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

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Paratyphi B var java	- (-)	- (-)	- (-)	2 (3)	- (-)
Poona	1 (1)	- (-)	- (-)	1 (1)	1 (1)
Reading	1 (1)	- (-)	- (-)	- (-)	1 (1)
Rubislaw	1 (1)	- (-)	- (-)	- (-)	- (-)
Ruiru	1 (2)	- (-)	- (-)	- (-)	- (-)
Schwarzengrund	1 (1)	- (-)	1 (2)	- (-)	6 (6)
Stanley	- (-)	- (-)	- (-)	1 (1)	2 (2)
Stourbridge	- (-)	- (-)	- (-)	2 (2)	1 (1)
Tees	- (-)	1 (1)	- (-)	- (-)	- (-)
Thompson	2 (2)	3 (3)	4 (5)	1 (1)	2 (4)
Typhimurium	238 (341)	148 (205)	140 (188)	159 (183)	140 (163)
Vejle	- (-)	- (-)	4 (8)	4 (4)	8 (8)
Virchow	1 (1)	1 (1)	1 (1)	- (-)	- (-)
ENTERICA DIARIZONAE					
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)	1 (1)
structure only	8 (9)	3 (3)	8 (11)	7 (7)	9 (10)
rough strain	1 (1)	3 (3)	2 (2)	4 (5)	3 (5)
untyped	3 (3)	- (-)	3 (4)	- (-)	- (-)
untypable	- (-)	- (-)	- (-)	- (1)	- (-)
TOTAL	1014 (1369)	629 (819)	1004 (1302)	1268 (1497)	1067 (1118)

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

**Fig 6: Seasonality of S. Dublin in cattle
(2000 - 2004)**

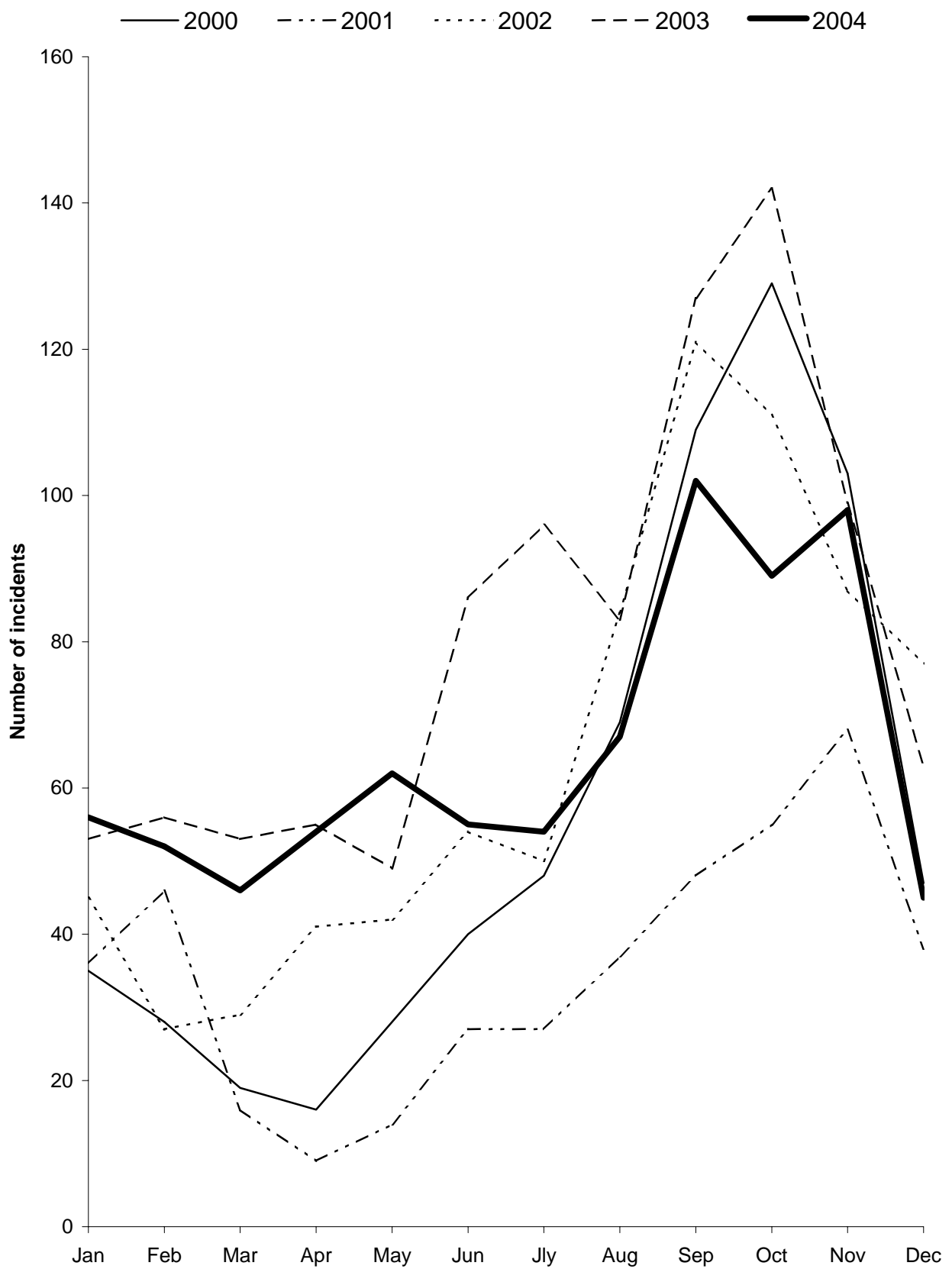


Fig 7: S. Enteritidis, S. Typhimurium and S. Dublin as a proportion of all incident reports in cattle (1985 - 2004)

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

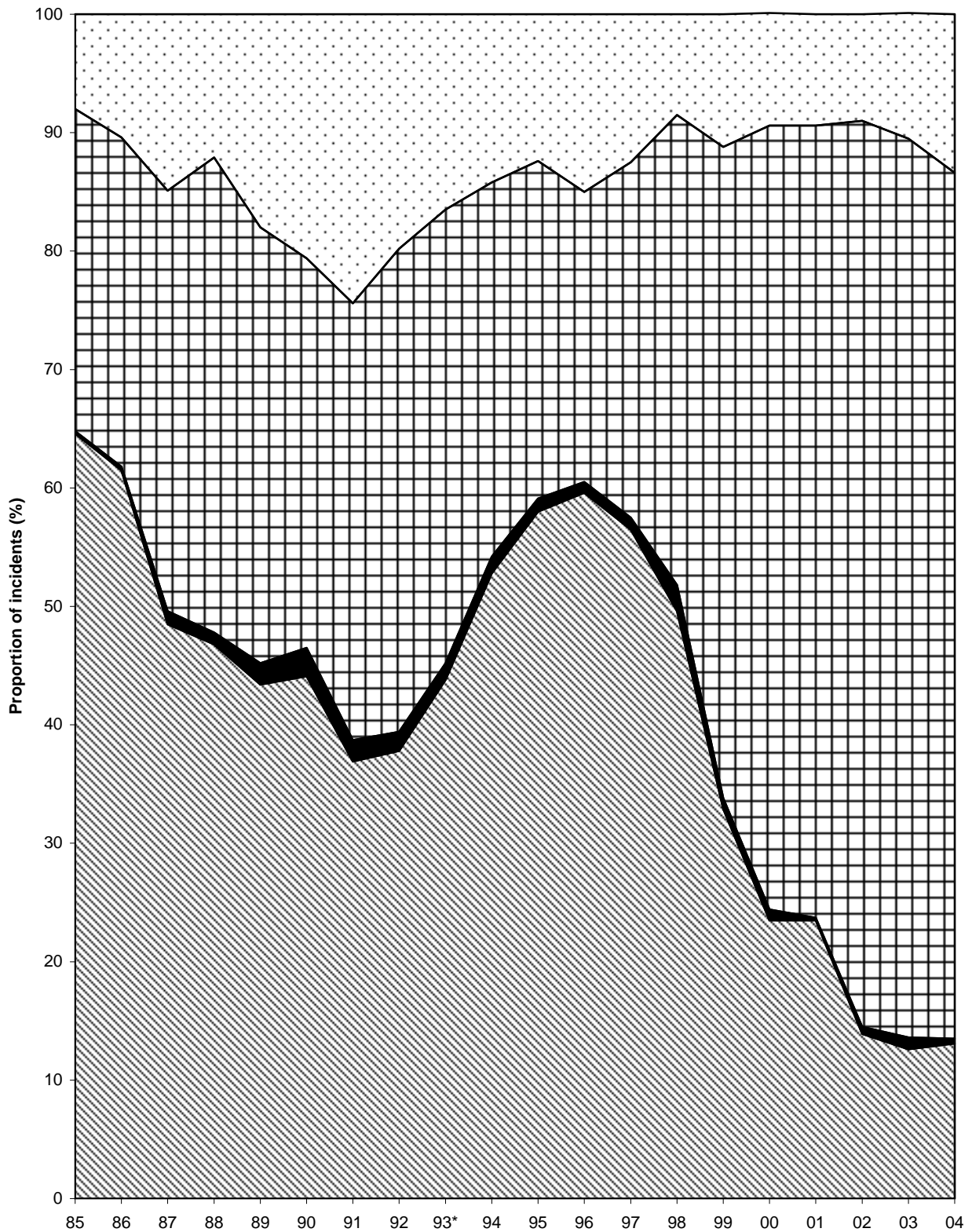


Table 11: *Salmonella* in adult cattle on all premises

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Agama	8 (10)	7 (9)	10 (12)	8 (8)	10 (10)
Agona	1 (1)	3 (5)	1 (1)	1 (1)	3 (3)
Ajiobo	1 (1)	- (-)	1 (1)	1 (1)	- (-)
Anatum	1 (1)	2 (2)	11 (20)	28 (29)	22 (23)
Ank	- (-)	- (-)	1 (1)	- (-)	- (-)
Binza	1 (1)	- (-)	- (-)	- (-)	- (-)
Bradford	- (-)	- (-)	- (-)	- (-)	1 (1)
Bredeney	- (-)	- (-)	1 (1)	- (-)	- (-)
Derby	- (-)	1 (1)	- (-)	1 (1)	2 (2)
Dublin	355 (499)	219 (279)	388 (509)	433 (452)	289 (292)
Enteritidis	5 (5)	1 (1)	1 (1)	6 (6)	3 (6)
Give	2 (2)	- (-)	1 (1)	- (-)	2 (2)
Goldcoast	8 (9)	- (-)	1 (1)	6 (6)	3 (3)
Havana	- (-)	- (-)	- (-)	1 (1)	- (-)
Heidelberg	1 (1)	1 (2)	- (-)	- (-)	- (-)
Infantis	2 (3)	- (2)	- (-)	1 (1)	- (-)
Kedougou	- (-)	- (-)	- (-)	7 (7)	4 (4)
Kentucky	2 (2)	- (-)	1 (1)	- (-)	- (-)
Kimuenza	- (-)	- (-)	- (-)	- (-)	1 (1)
Kottbus	- (-)	- (-)	- (-)	- (-)	1 (1)
Larochelle	- (-)	- (-)	- (-)	- (-)	1 (1)
Liverpool	- (-)	- (-)	- (-)	- (-)	1 (1)
London	- (-)	- (-)	- (-)	- (-)	2 (3)
Mbandaka	- (3)	- (-)	1 (1)	- (-)	1 (1)
Montevideo	1 (3)	3 (3)	1 (1)	2 (2)	4 (4)
Nagoya	- (-)	- (-)	1 (1)	1 (1)	- (-)
Newington	- (-)	1 (1)	- (-)	- (-)	- (-)
Newport	2 (2)	4 (4)	7 (8)	5 (5)	5 (6)
Oslo	- (-)	- (-)	- (-)	3 (3)	- (-)
Poona	1 (1)	- (-)	- (-)	1 (1)	- (-)
Ruiru	1 (2)	- (-)	- (-)	- (-)	- (-)
Schwarzengrund	1 (1)	- (-)	1 (1)	- (-)	5 (5)
Stanley	- (-)	- (-)	- (-)	- (-)	2 (2)
Stourbridge	- (-)	- (-)	- (-)	2 (2)	1 (1)

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

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Tees	- (-)	1 (1)	- (-)	- (-)	- (-)
Thompson	2 (2)	3 (3)	3 (4)	- (-)	1 (1)
Typhimurium	120 (165)	65 (85)	74 (89)	76 (83)	72 (88)
Vejle	- (-)	- (-)	2 (4)	3 (3)	6 (6)
Virchow	- (-)	1 (1)	- (-)	- (-)	- (-)
ENTERICA DIARIZONAE					
61:-:1,5,7	- (-)	- (-)	- (-)	- (-)	1 (1)
61:-:1,5	- (-)	- (-)	1 (1)	- (-)	- (-)
61:k:1,5,7	- (-)	1 (1)	1 (1)	2 (2)	- (-)
structure only	3 (3)	- (-)	2 (3)	2 (2)	5 (6)
rough strain	- (-)	2 (2)	1 (1)	2 (2)	1 (1)
untyped	3 (3)	- (-)	1 (1)	- (-)	- (-)
TOTAL	521 (720)	315 (402)	513 (655)	592 (619)	449 (475)

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

Fig 8: Incidents of *Salmonella* serotypes in adult cattle in 2004

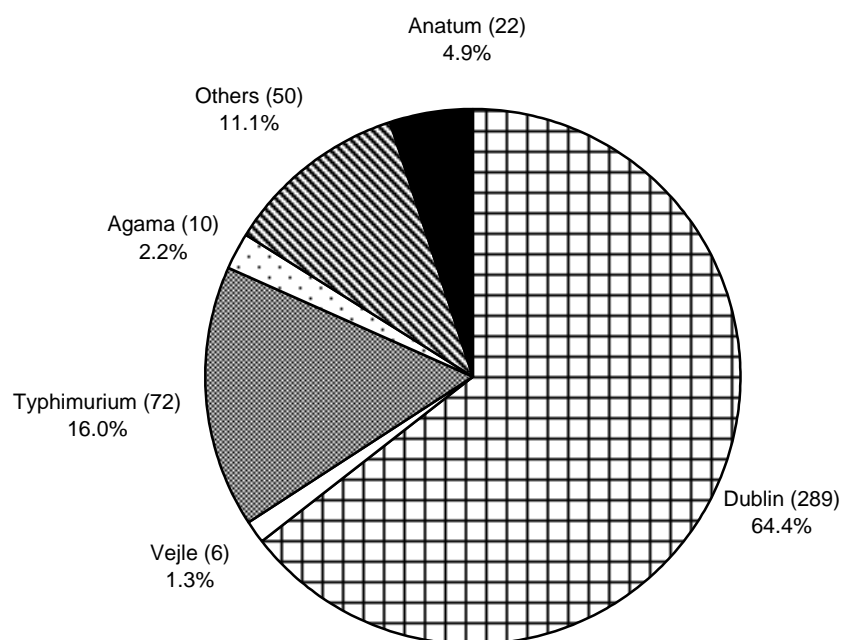
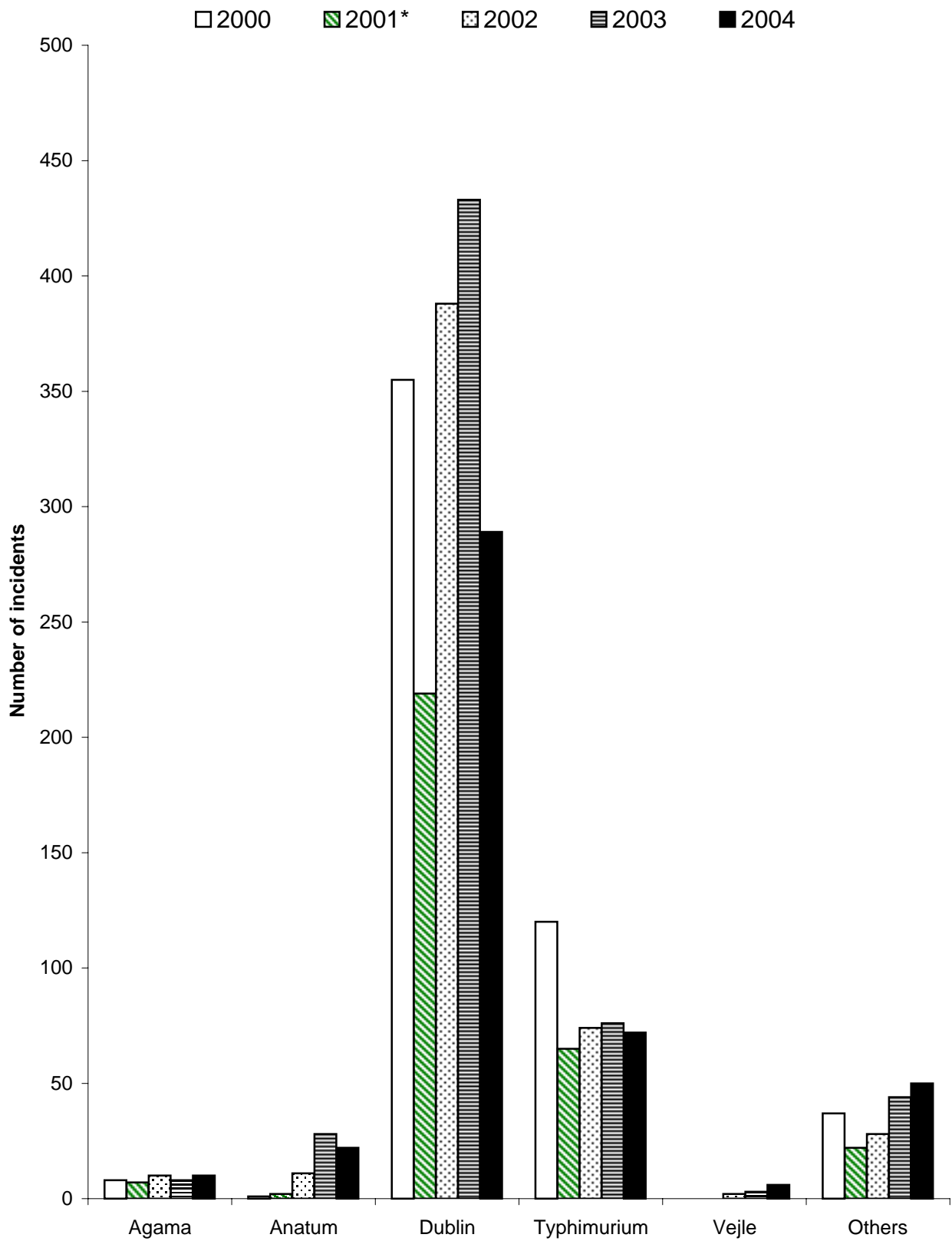


Table 12: Incidents of the top 5 *Salmonella* serotypes in adult cattle in 2004 as a % of all incidents compared to previous years

Serotype	2000	2001	2002	2003	2004
S. Dublin %	68.1	69.5	75.6	73.1	64.4
S. Typhimurium %	23.0	20.6	14.4	12.8	16.0
S. Anatum %	0.2	0.6	2.1	4.7	4.9
S. Agama %	1.5	2.2	1.9	1.4	2.2
S. Vejle %	0	0	0.4	0.5	1.3
Total no. incidents	521	315	513	592	449

Fig 9: Number of incidents of *Salmonella* serotypes in adult cattle (2000 - 2004)



* 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)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Agama	9 (10)	5 (6)	2 (5)	4 (4)	2 (2)
Agona	4 (4)	1 (1)	2 (2)	3 (3)	3 (3)
Ajiobo	- (-)	- (-)	1 (1)	- (-)	- (-)
Anatum	1 (2)	- (1)	4 (5)	7 (7)	5 (7)
Binza	- (-)	- (-)	- (-)	- (-)	2 (2)
Bovis morbificans	- (-)	- (-)	- (-)	- (-)	1 (1)
Braenderup	1 (1)	1 (1)	- (-)	- (-)	- (-)
Brandenburg	2 (2)	- (-)	- (-)	- (-)	- (-)
Derby	- (-)	1 (2)	- (-)	1 (1)	- (-)
Dublin	265 (321)	150 (183)	300 (353)	412 (432)	339 (350)
Durham	- (-)	1 (1)	- (-)	- (-)	- (-)
Enteritidis	2 (2)	- (-)	4 (4)	4 (4)	1 (1)
Give	2 (2)	- (-)	- (-)	- (-)	- (-)
Goldcoast	2 (2)	3 (3)	- (-)	1 (1)	1 (1)
Havana	- (-)	1 (1)	- (-)	- (-)	- (-)
Infantis	- (-)	- (-)	1 (1)	- (-)	- (-)
Kedougou	1 (1)	- (-)	- (-)	3 (3)	1 (1)
Kentucky	1 (1)	- (-)	- (-)	- (-)	- (-)
Kimuenza	- (-)	- (-)	- (-)	3 (4)	- (-)
Kottbus	- (-)	- (-)	1 (1)	- (-)	- (-)
Livingstone	1 (1)	- (-)	- (-)	- (-)	- (-)
London	- (-)	- (-)	- (-)	- (-)	1 (1)
Mbandaka	- (-)	- (-)	1 (1)	- (-)	1 (1)
Montevideo	3 (3)	- (-)	- (-)	2 (2)	- (-)
Nagoya	- (-)	1 (1)	1 (1)	- (-)	- (-)
Newport	2 (4)	2 (2)	2 (2)	- (-)	1 (1)
Orion	1 (3)	- (-)	- (-)	- (-)	- (-)
Oslo	- (-)	- (-)	- (-)	2 (2)	- (-)
Paratyphi B var java	1 (1)	- (-)	- (-)	1 (1)	- (-)
Poona	- (-)	- (-)	- (-)	- (-)	1 (1)
Reading	1 (1)	- (-)	- (-)	- (-)	1 (1)
Thompson	- (-)	- (-)	1 (1)	- (-)	1 (2)
Typhimurium	86 (109)	47 (60)	45 (56)	46 (51)	30 (34)

Table 13: *Salmonella* in calves on all premises

<i>Salmonella</i> Incidents (Isolations)	2000	2001*	2002	2003	2004
ENTERICA ENTERICA					
Vejle	- (-)	- (-)	- (-)	- (-)	1 (1)
ENTERICA DIARIZONAE					
61:k:1,5,7	2 (2)	- (-)	- (-)	- (-)	- (-)
structure only	2 (3)	2 (2)	5 (7)	2 (2)	4 (4)
rough strain	1 (1)	1 (1)	1 (1)	1 (2)	2 (2)
untyped	- (-)	- (-)	1 (1)	- (-)	- (-)
TOTAL	390 (476)	216 (265)	372 (442)	492 (519)	398 (416)

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

Fig 10: Incidents of *Salmonella* serotypes in calves in 2004

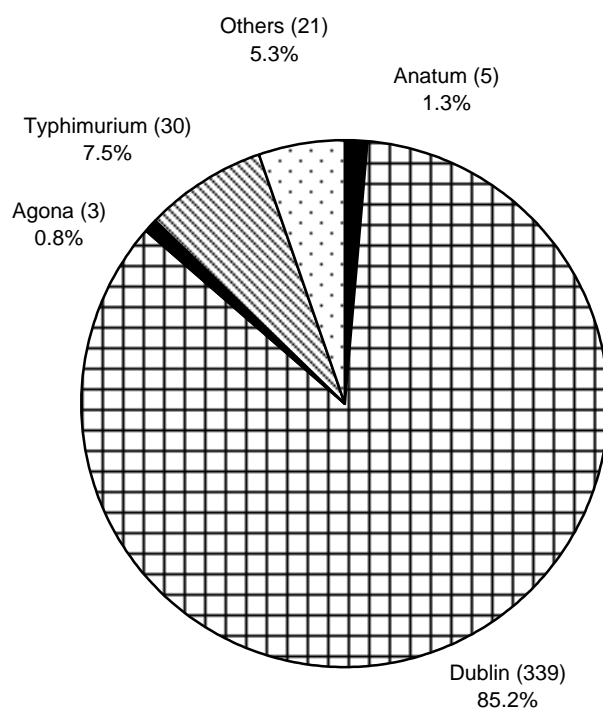
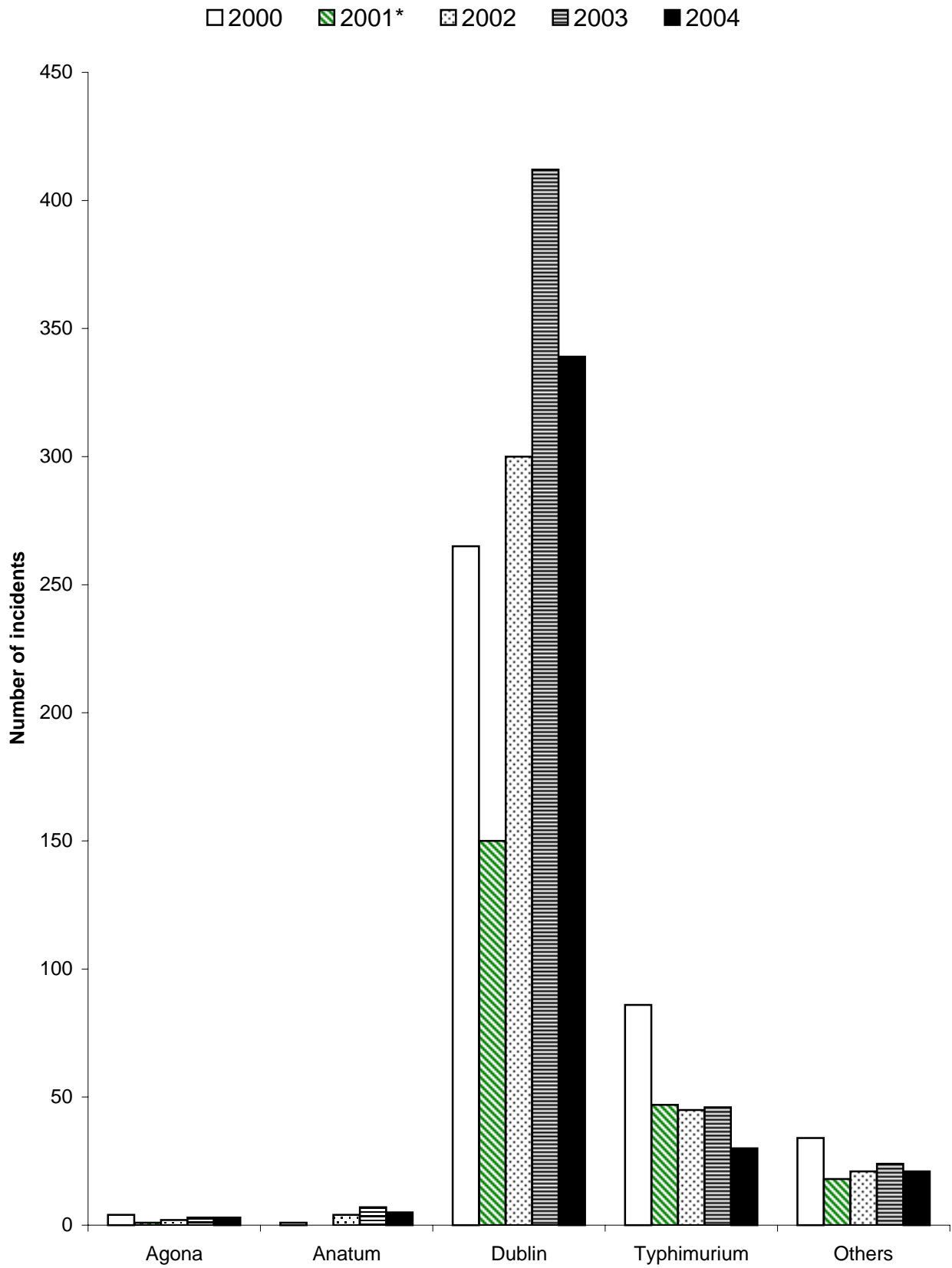


Table 14: Incidents of the top 5 *Salmonella* serotypes in calves in 2004 as a % of all incidents compared to previous years

Serotype	2000	2001	2002	2003	2004
S. Dublin %	67.9	69.4	80.6	83.7	85.2
S. Typhimurium %	22.1	21.8	12.1	9.3	7.5
S. Anatum %	0.3	0	1.1	1.4	1.3
S. Agona %	1.0	0.5	0.5	0.6	0.8
S. Agama %	2.3	2.3	0.5	0.8	0.5
S. Binza %	0.0	0.0	0.0	0.0	0.5
Total no. incidents	390	216	372	492	398

Fig 11: Number of incidents of *Salmonella* serotypes in calves (2000 - 2004)



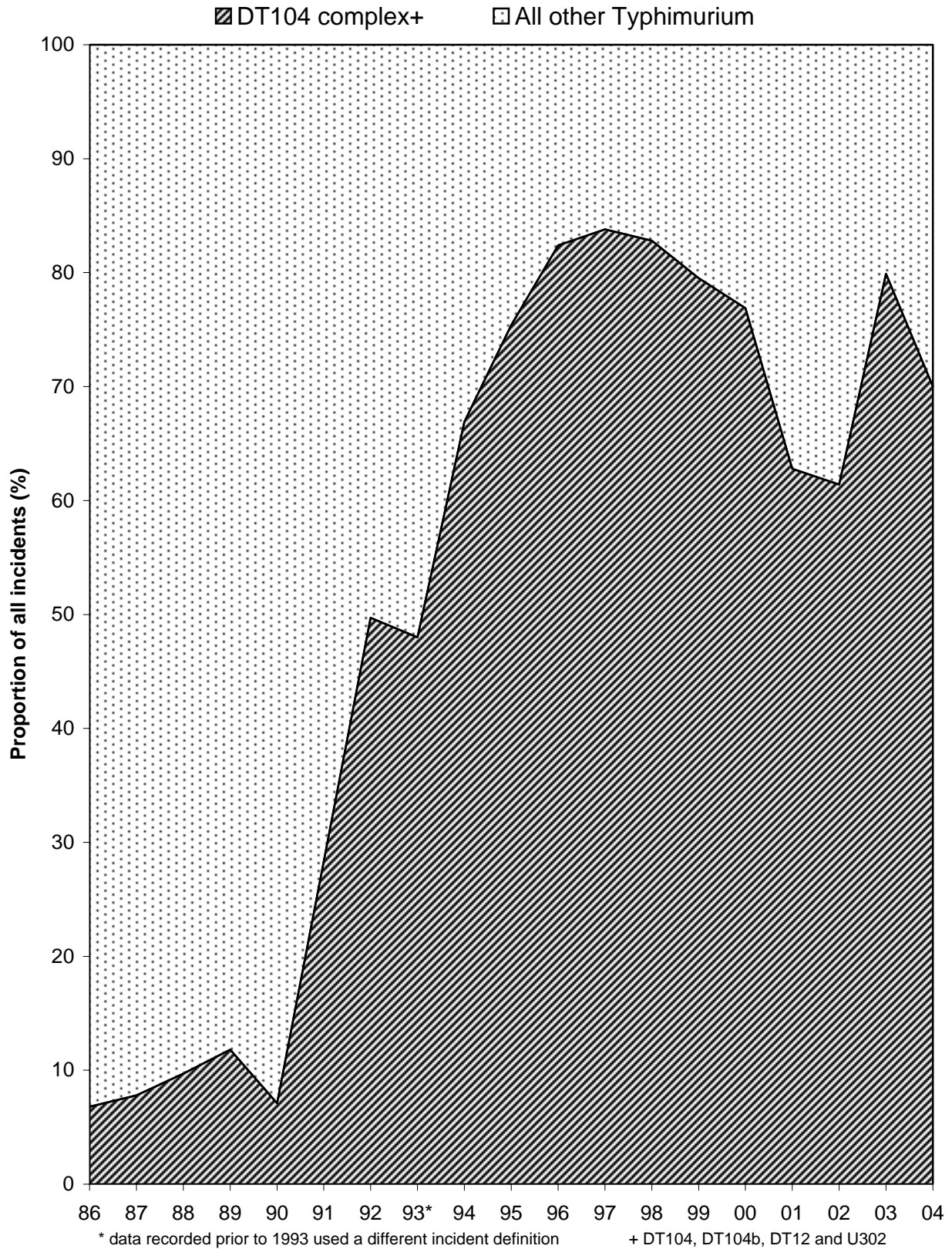
* 2001 data may not be comparable due to uncertain impact of FMD epidemic

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

Definitive Types Incidents (Isolations)	2000	2001*	2002	2003	2004
2	- (-)	- (-)	1 (1)	- (-)	- (-)
8	- (-)	1 (1)	- (-)	1 (1)	- (-)
12	- (-)	2 (2)	6 (8)	6 (6)	5 (5)
17	1 (1)	- (-)	- (-)	- (-)	- (-)
40	1 (1)	1 (1)	2 (2)	1 (2)	3 (3)
41	1 (2)	1 (1)	1 (1)	2 (2)	2 (2)
49	1 (1)	- (-)	- (-)	2 (2)	3 (3)
56	- (-)	- (-)	2 (2)	1 (1)	3 (3)
67	1 (1)	- (-)	- (-)	- (-)	- (-)
69	- (-)	2 (3)	- (-)	- (-)	- (-)
99	1 (1)	- (-)	- (-)	- (-)	- (-)
103	- (-)	1 (1)	- (-)	- (-)	- (-)
104	164 (244)	80 (118)	60 (89)	97 (107)	76 (81)
104b	4 (6)	5 (7)	5 (10)	10 (10)	7 (7)
104c	1 (1)	- (-)	- (-)	- (-)	- (-)
108	1 (1)	- (-)	- (-)	- (-)	- (-)
120	7 (7)	6 (6)	4 (4)	1 (1)	6 (6)
166	- (-)	- (-)	- (-)	1 (1)	- (-)
169	- (-)	- (-)	- (-)	1 (1)	- (-)
170	5 (5)	3 (5)	6 (7)	0 (2)	2 (2)
193	11 (17)	6 (10)	3 (6)	4 (4)	6 (6)
193a	- (-)	- (-)	2 (3)	4 (6)	6 (6)
195	- (-)	- (-)	- (-)	1 (1)	2 (2)
208	1 (1)	3 (6)	5 (6)	4 (4)	- (-)
U288	- (-)	- (-)	- (-)	2 (2)	- (-)
U302	14 (21)	6 (9)	15 (19)	14 (16)	10 (10)
U308a	- (-)	2 (2)	- (-)	- (-)	- (-)
U310	- (-)	1 (1)	- (-)	6 (6)	9 (9)
U311	- (-)	- (-)	- (-)	1 (1)	- (-)
RDNC	1 (1)	3 (3)	10 (11)	0 (1)	- (1)
NOPT	1 (1)	1 (1)	- (-)	0 (1)	- (1)
UNTY	22 (29)	20 (23)	9 (9)	0 (4)	- (5)
Untyped	- (-)	4 (5)	9 (10)	- (-)	- (11)
TOTAL	238 (341)	148 (205)	140 (188)	159 (183)	140 (163)

* 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 - 2004



**Fig 13: Seasonality of *S. Typhimurium* DT104 in cattle
(2000 - 2004)**

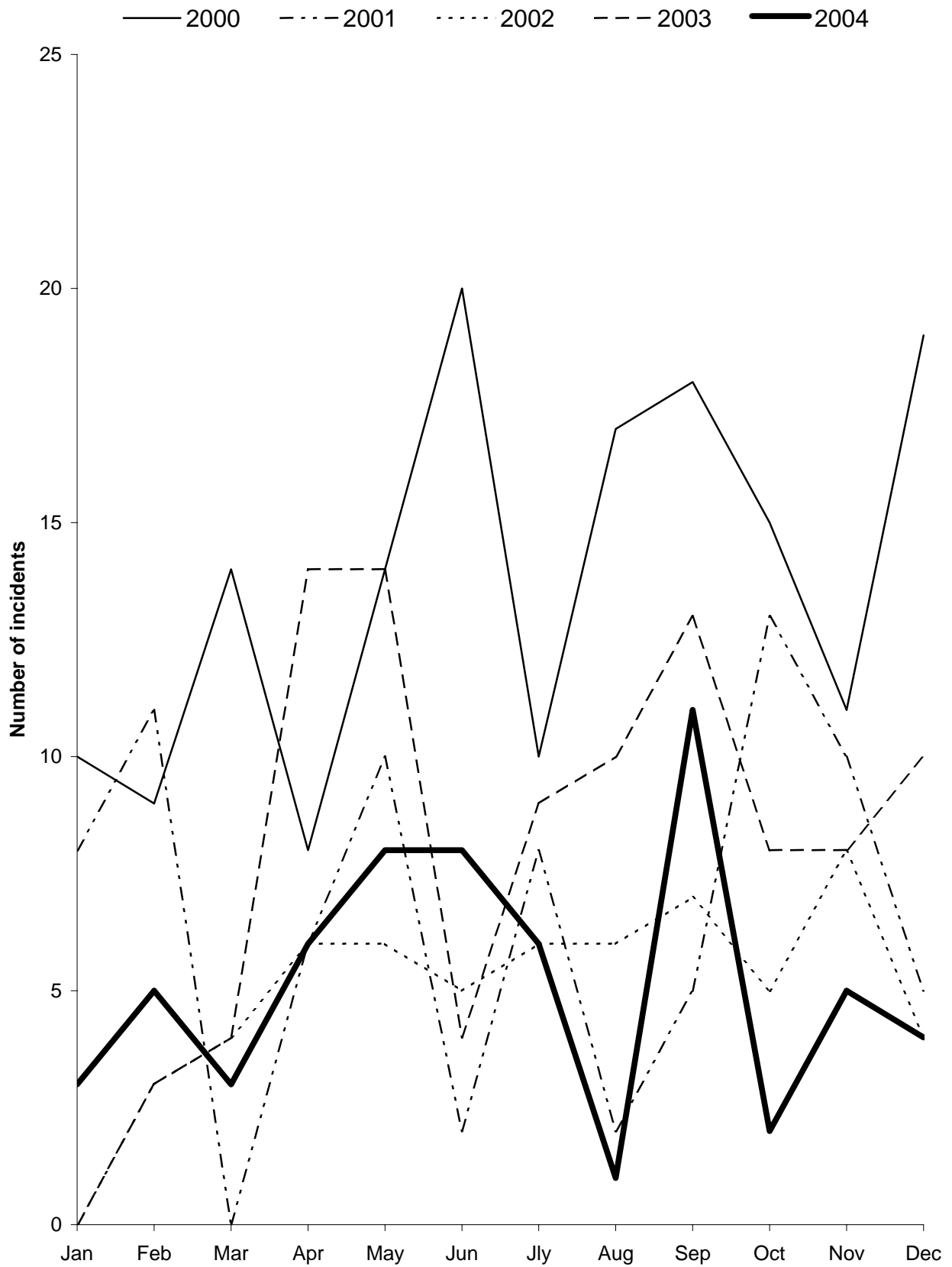


Table 16: S.Typhimurium in adult cattle on all premises

Definitive Types Incidents (Isolations)	2000	2001*	2002	2003	2004
12	- (-)	1 (1)	3 (4)	6 (6)	3 (3)
40	- (-)	- (-)	2 (2)	- (-)	2 (2)
41	- (-)	1 (1)	1 (1)	1 (1)	1 (1)
49	- (-)	- (-)	- (-)	2 (2)	2 (2)
56	- (-)	- (-)	- (-)	- (-)	1 (1)
67	1 (1)	- (-)	- (-)	- (-)	- (-)
69	- (-)	1 (2)	- (-)	- (-)	- (-)
99	1 (1)	- (-)	- (-)	- (-)	- (-)
104	82 (117)	37 (48)	28 (38)	38 (41)	38 (43)
104b	1 (1)	2 (2)	2 (3)	4 (4)	4 (4)
104c	1 (1)	- (-)	- (-)	- (-)	- (-)
108	1 (1)	- (-)	- (-)	- (-)	- (-)
120	2 (2)	1 (1)	2 (2)	- (-)	4 (4)
166	- (-)	- (-)	- (-)	1 (1)	- (-)
169	- (-)	- (-)	- (-)	1 (1)	- (-)
170	3 (3)	2 (4)	5 (5)	- (-)	- (-)
193	8 (11)	3 (4)	1 (1)	4 (4)	4 (4)
193a	- (-)	- (-)	1 (2)	3 (4)	3 (3)
195	- (-)	- (-)	- (-)	1 (1)	1 (1)
208	1 (1)	3 (4)	3 (4)	3 (3)	- (-)
U302	7 (9)	2 (3)	10 (11)	7 (8)	5 (5)
U308a	- (-)	1 (1)	- (-)	- (-)	- (-)
U310	- (-)	- (-)	- (-)	4 (4)	4 (4)
U311	- (-)	- (-)	- (-)	1 (1)	- (-)
RDNC	1 (1)	1 (1)	7 (7)	- (-)	- (-)
NOPT	- (-)	- (-)	- (-)	- (-)	- (1)
UNTY	11 (16)	9 (11)	5 (5)	0 (2)	- (3)
Untyped	- (-)	1 (2)	4 (4)	- (-)	- (7)
TOTAL	120 (165)	65 (85)	74 (89)	76 (83)	72 (88)

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

Fig 14: Incidents of Salmonella Typhimurium definitive types in adult cattle in 2004

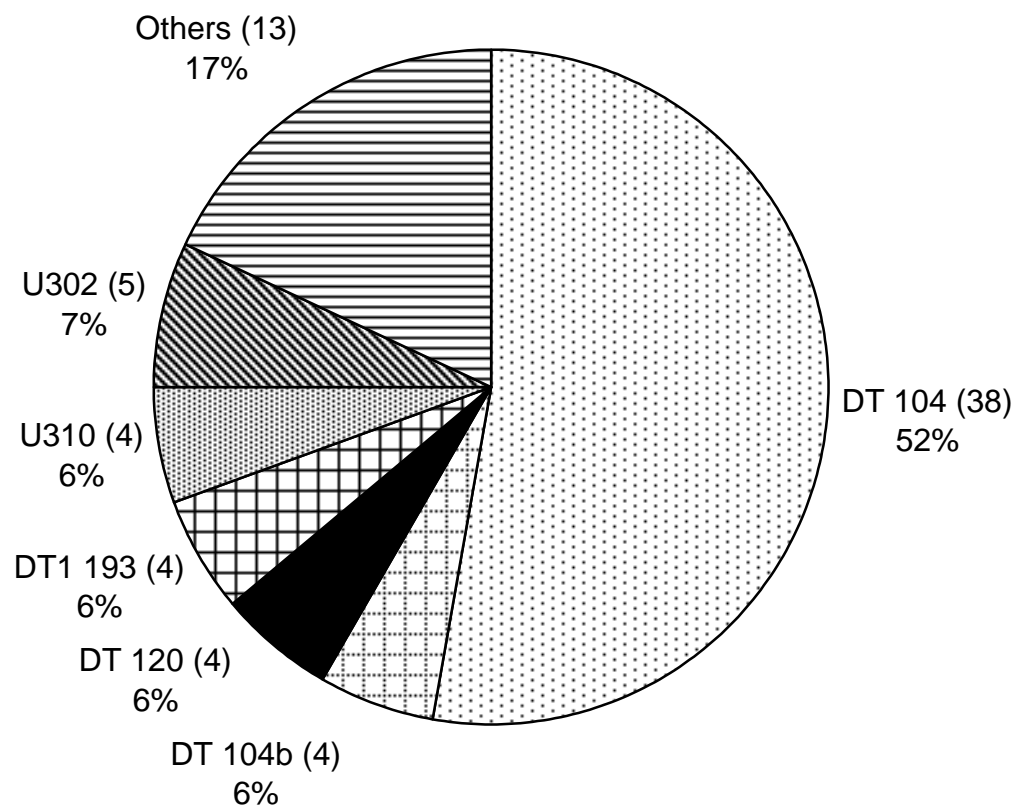
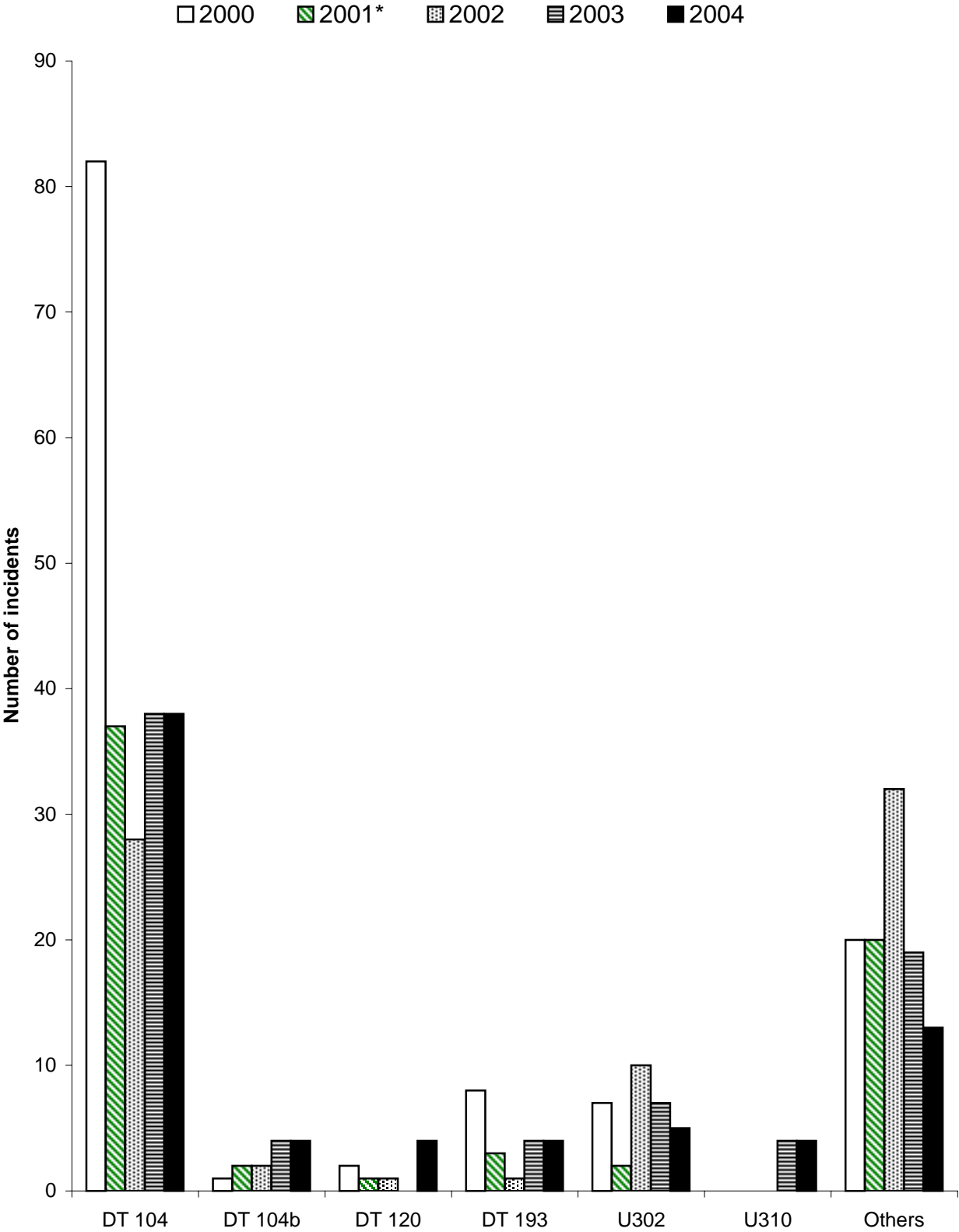


Fig 15: Incidents of *Salmonella* Typhimurium definitive types in adult cattle (2000 - 2004)



* 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)	2000	2001*	2002	2003	2004
8	- (-)	1 (1)	- (-)	1 (1)	- (-)
12	- (-)	- (-)	1 (2)	- (-)	- (-)
17	1 (1)	- (-)	- (-)	- (-)	- (-)
40	1 (1)	- (-)	- (-)	1 (1)	- (-)
41	1 (1)	- (-)	- (-)	- (-)	- (-)
49	- (-)	- (-)	- (-)	- (-)	1 (1)
56	- (-)	- (-)	2 (2)	1 (1)	1 (1)
69	- (-)	1 (1)	- (-)	- (-)	- (-)
103	- (-)	1 (1)	- (-)	- (-)	- (-)
104	60 (80)	29 (39)	25 (32)	32 (33)	20 (20)
104b	1 (1)	2 (3)	2 (4)	4 (4)	1 (1)
120	4 (4)	3 (3)	2 (2)	- (-)	- (-)
170	1 (1)	1 (1)	- (1)	- (-)	- (-)
193	3 (3)	1 (1)	1 (1)	- (-)	1 (1)
193a	- (-)	- (-)	1 (1)	- (1)	2 (2)
208	- (-)	- (1)	1 (1)	- (-)	- (-)
U288	- (-)	- (-)	- (-)	1 (1)	- (-)
U302	5 (7)	2 (3)	4 (4)	5 (6)	3 (3)
U308a	- (-)	1 (1)	- (-)	- (-)	- (-)
U310	- (-)	1 (1)	- (-)	1 (1)	1 (1)
RDNC	- (-)	- (-)	2 (2)	- (-)	- (-)
NOPT	1 (1)	- (-)	- (-)	- (-)	- (-)
UNTY	8 (9)	2 (2)	3 (3)	0 (2)	- (2)
Untyped	- (-)	2 (2)	1 (1)	- (-)	- (2)
TOTAL	86 (109)	47 (60)	45 (56)	46 (51)	30 (34)

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

Fig 16: Incidents of *Salmonella* Typhimurium definitive types in calves in 2004

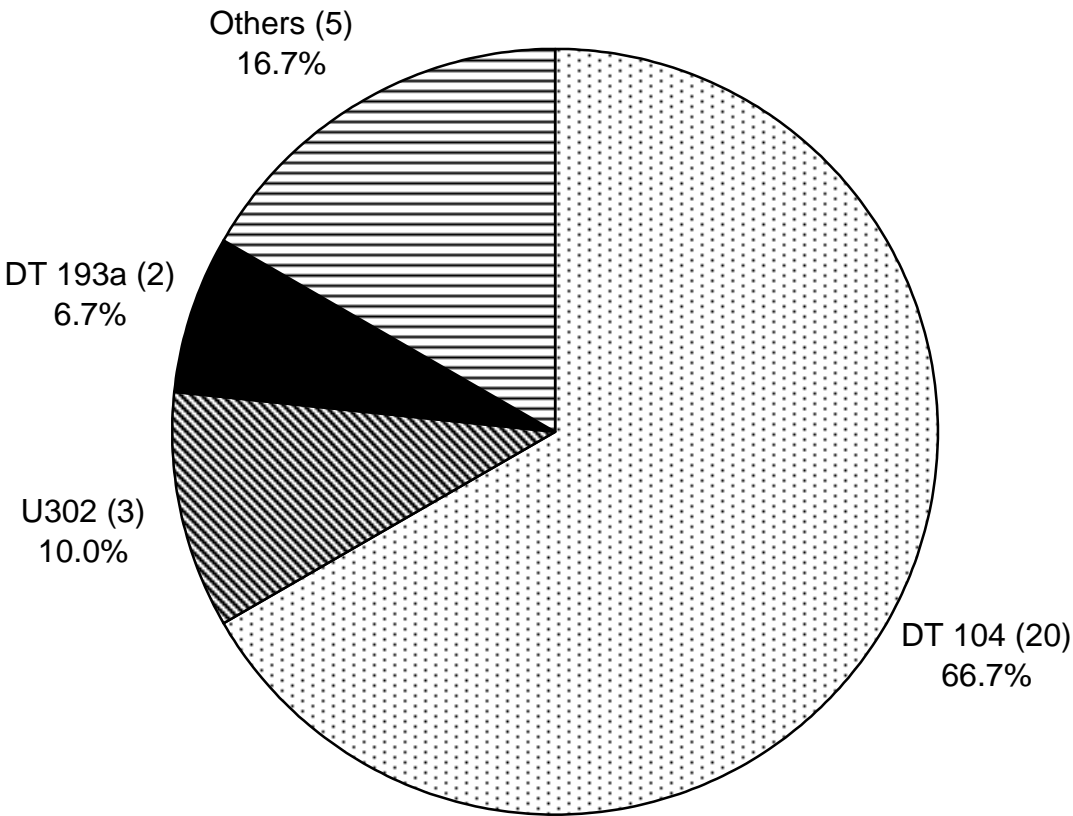
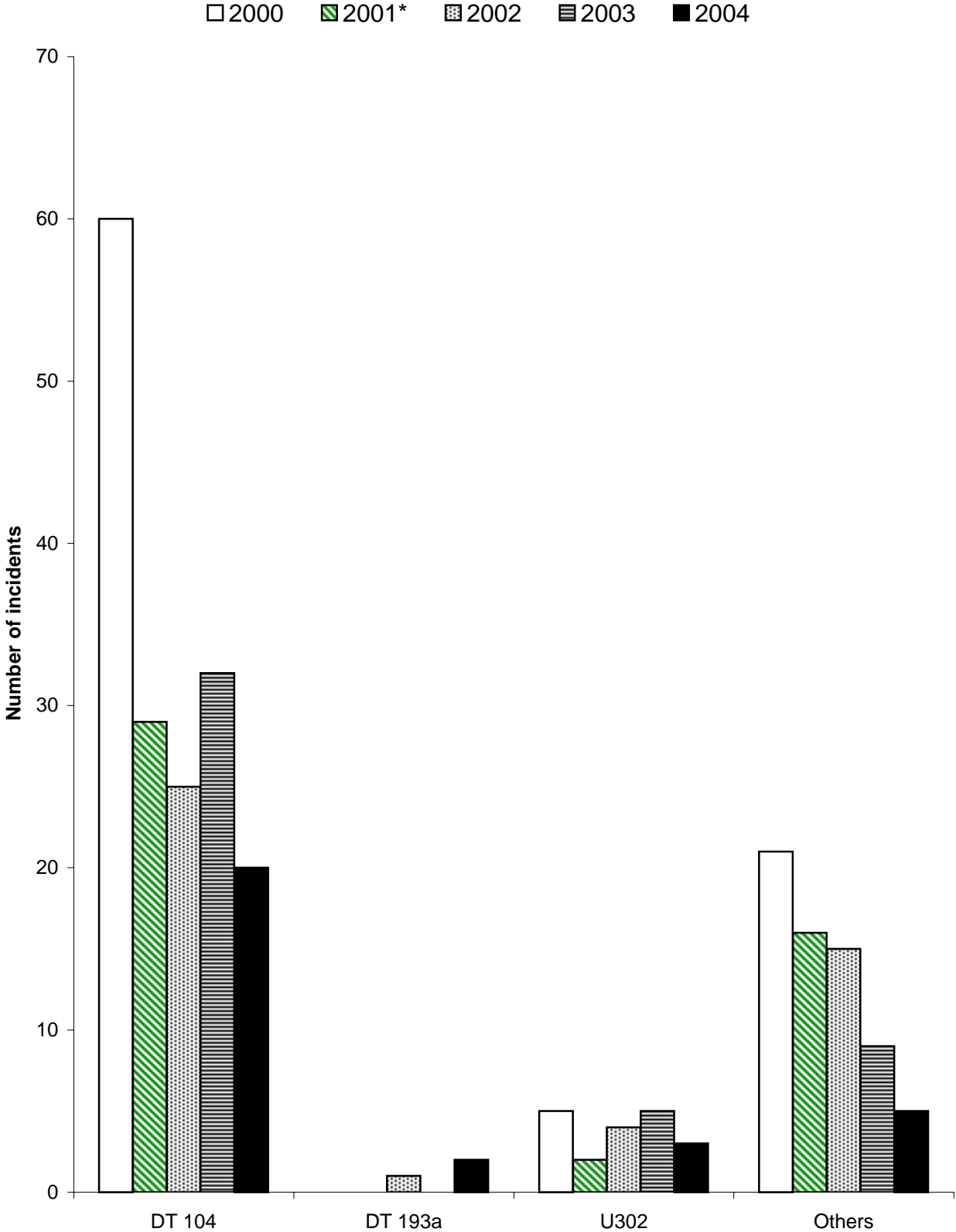


Fig 17: Incidents of *Salmonella* Typhimurium definitive types in calves (2000 - 2004)



* 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)	2000		2001*		2002		2003		2004	
1	1	(1)	-	(-)	-	(-)	3	(3)	2	(2)
4	3	(3)	1	(1)	2	(2)	1	(1)	1	(1)
5	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
6	-	(-)	-	(-)	2	(2)	-	(-)	-	(-)
6a	-	(-)	-	(-)	1	(1)	1	(1)	-	(-)
7	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
8	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
9a	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
11	1	(1)	-	(-)	-	(-)	0	(1)	-	(-)
13a	-	(-)	-	(-)	1	(1)	6	(6)	1	(1)
21	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
24	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
RDNC	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
UNTY	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
untyped	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
TOTAL	9	(9)	1	(1)	6	(6)	13	(14)	4	(7)

* 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)	2000		2001*		2002		2003		2004	
1	1	(1)	-	(-)	-	(-)	2	(2)	2	(2)
4	2	(2)	1	(1)	1	(1)	1	(1)	1	(1)
5	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
7	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
8	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
13a	-	(-)	-	(-)	-	(-)	1	(1)	-	(-)
24	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
RDNC	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
UNTY	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
untyped	-	(-)	-	(-)	-	(-)	-	(-)	-	(1)
TOTAL	5	(5)	1	(1)	1	(1)	6	(6)	3	(6)

Table 20: S. Enteritidis in calves on all premises

Phage Types Incidents (Isolations)	2000		2001*		2002		2003		2004	
6	-	(-)	-	(-)	2	(2)	-	(-)	-	(-)
6a	-	(-)	-	(-)	1	(1)	1	(1)	-	(-)
9a	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
13a	-	(-)	-	(-)	1	(1)	3	(3)	1	(1)
21	1	(1)	-	(-)	-	(-)	-	(-)	-	(-)
TOTAL	2	(2)	-	(-)	4	(4)	4	(4)	1	(1)

* 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)	2000	2001*	2002	2003	2004
9	- (-)	- (-)	- (-)	1 (1)	- (-)
Totals	- (-)	- (-)	- (-)	1 (1)	- (-)

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

Phage Types Incidents (Isolations)	2000	2001*	2002	2003	2004
1	- (-)	- (-)	- (-)	- (-)	2 (2)
3	- (-)	- (-)	- (-)	1 (1)	- (-)
23	1 (1)	2 (2)	- (-)	- (-)	- (-)
RDNC	1 (1)	- (-)	- (-)	- (-)	- (-)
NOPT	- (-)	1 (1)	4 (5)	- (-)	- (2)
TOTAL	2 (2)	3 (3)	4 (5)	1 (1)	2 (4)

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

Phage Types Incidents (Isolations)	2000	2001*	2002	2003	2004
9	1 (1)	- (-)	- (-)	- (-)	- (-)
26	- (-)	- (-)	1 (1)	- (-)	- (-)
50	- (-)	1 (1)	- (-)	- (-)	- (-)
TOTAL	1 (1)	1 (1)	1 (1)	- (-)	- (-)

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