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SCIENTIFIC REPORT OF EFSA

Analysis of the baseline survey on the prevalence of *Salmonella* in holdings with breeding pigs in the EU, 2008[1]

Part A: *Salmonella* prevalence estimates

European Food Safety Authority[2, 3]

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ABSTRACT

Salmonella is a major cause of food-borne illness in humans. Farm animals and foods of animal origin are important sources of human *Salmonella* infections. This European Union-wide *Salmonella* baseline survey was conducted in 2008 in holdings with breeding pigs. A total of 1,609 holdings housing and selling mainly breeding pigs (breeding holdings) and 3,508 holdings housing breeding pigs and selling mainly pigs for fattening or slaughter (production holdings) from 24 European Union Member States and two non-Member States, were randomly selected and included in the survey. In each selected breeding and production holding, fresh voided pooled faecal samples were collected from 10 randomly chosen pens, yards or groups of breeding pigs over six months of age, representing the different stages of the breeding herd. The pooled faecal samples from each holding were tested for *Salmonella* and the isolates were serotyped. The overall European Union prevalence of *Salmonella*-positive holdings with breeding pigs was 31.8% and all but one of the 24 participating Member States detected *Salmonella* in at least one holding. The European Union prevalence of *Salmonella*-positive breeding holdings was 28.7%, and prevalence varied from 0% to 64.0% among Member States. The European Union prevalence of *Salmonella*-positive production holdings was 33.3%, while the Member States' prevalence varied from 0% to 55.7%. The number of different *Salmonella* serovars isolated in breeding holdings and production holdings in the European Union was 54 and 88, respectively. *Salmonella* Derby and *Salmonella* Typhimurium predominated in both types of holdings. Breeding pigs may be an important source of dissemination of *Salmonella* throughout the pig-production chain. The results of this survey provide valuable information for setting a *Salmonella* reduction target for breeding pigs and for assessing the impact of *Salmonella* transmission originating from holdings with breeding pigs. The baseline figures may be used in the future to follow trends and to evaluate the impact of control programmes.

KEY WORDS

Salmonella, pigs, breeding pigs, survey, prevalence, EU.

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SUMMARY

Salmonella is a major cause of food-borne illness in humans. Farm animals and foods of animal origin are important sources of human *Salmonella* infections. Therefore, in order to reduce the incidence of human salmonellosis in the European Union, Community legislation foresees the setting of *Salmonella* reduction targets for food/animal populations, including breeding pigs. To underpin such targets, a series of baseline surveys have been conducted to ascertain the occurrence prior to the implementation of such Community legislation. This fifth European Union-wide baseline survey was carried out at farm level to determine the prevalence of *Salmonella* in pig breeding holdings. The herds were randomly selected from holdings constituting at least 80% of the breeding pig population in a Member State.

Sampling took place between January 2008 and December 2008. A total of 1,609 holdings housing and selling mainly breeding pigs (sows or boars of at least six months of age kept for breeding purposes) (breeding holdings) and 3,508 holdings housing breeding pigs and selling mainly pigs for fattening or slaughter (production holdings) from 24 European Union Member States, plus Norway and Switzerland were included in the survey. In each selected breeding and production holding, fresh voided pooled faecal samples were collected from 10 randomly chosen pens, yards or groups of breeding pigs over six months of age, representing the different stages of production of the breeding herd (maiden gilts, pregnant pigs, farrowing and lactating pigs, pigs in the service area, or mixed). The pooled samples from each holding were tested for the presence of *Salmonella* and the isolates were serotyped. The country level and European Union level prevalence presented in the report are apparent prevalence, meaning that the prevalence estimates do not account for imperfect sampling and test characteristics.

The overall European Union prevalence of *Salmonella*-positive holdings with breeding pigs was 31.8% and all but one participating Member State detected *Salmonella* in at least one holding. Twenty of the 24 Member States isolated *Salmonella* in breeding holdings and at European Union level 28.7% of the holdings was estimated to be positive for *Salmonella*. This prevalence varied from 0% to 64.0% among the Member States. The estimated European Union prevalence of breeding holdings positive to *Salmonella* Typhimurium and to *Salmonella* Derby was 7.8% and 8.9%, respectively.

Twenty-one of the 24 Member States isolated *Salmonella* in production holdings and at the European Union level 33.3% of the production holdings was estimated to be positive for *Salmonella*. This prevalence varied from 0% to 55.7% among the Member States. The estimated European Union prevalence of production holdings positive for *Salmonella* Typhimurium and *Salmonella* Derby was 6.6% and 9.0%, respectively. For the two non-Member States, Switzerland detected *Salmonella* in both breeding and production holdings while Norway did not detect any *Salmonella* in its surveyed holdings.

The number of different *Salmonella* serovars isolated in breeding holdings and production holdings across the European Union was 54 and 88, respectively. *Salmonella* Derby was the most frequently isolated serovar in both breeding and production holdings, detected in 29.6% and 28.5% of the *Salmonella*-positive holdings, respectively. The next most commonly isolated serovar was *Salmonella* Typhimurium accounting for 25.4% and 20.1% of *Salmonella*-positive breeding holdings and production holdings, respectively. These serovars were also commonly found in the EU-wide baseline survey of fattening pigs at slaughter in 2006-2007. The next most frequently reported serovars were *Salmonella* London, *Salmonella* Infantis and *Salmonella* Rissen both in breeding and production holdings and each accounted for approximately 7% of the positive holdings, in each type of holding. Also *Salmonella* isolates with the incomplete antigenic formula 4,[5],12:i:-, which are likely to be related to the recent emergence of monophasic *Salmonella* Typhimurium, were reported by several Member States.

Salmonella infection in breeding pigs may be transmitted to slaughter pigs through trade and movement of live animals and contamination of holding, transport, lairage and slaughter facilities. This may lead to *Salmonella*-contamination of pig meat and consequently to human disease. Further studies in surveillance and control methods for *Salmonella* in breeding pigs as well as in the public health importance of consumption of meat from culled breeding pigs are recommended. Also investigations on the epidemiology of monophasic *Salmonella* Typhimurium would be welcome. The results of this survey provide valuable information for the assessment of the impact of *Salmonella* transmission originating from holdings with breeding pigs as a source of *Salmonella* in the food chain. These baseline prevalence figures may be used for the setting of targets for the reduction of *Salmonella* in breeding pigs, to follow trends and to evaluate the impact of control programmes.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

Regulation (EC) No 2160/2003 on the control of *Salmonella* spp. and other specified zoonotic agents (EC, 2003b) provides for the setting of Community targets for reducing the prevalence of *Salmonella* serovars with public health significance in food/animal populations. Furthermore, these targets are to be set for breeding herds of pigs. For the purpose of target setting, several European Union-wide baseline surveys have been carried out.

Upon a request of the European Commission, the European Food Safety Authority (EFSA) adopted a "Report of the Task Force on Zoonoses Data Collection on a proposal for technical specifications for a baseline survey on the prevalence of *Salmonella* in breeding pigs (EFSA, 2007b)".

Based on the EFSA proposal, the Commission adopted Decision 2008/55/EC of 20 December 2007 concerning a financial contribution from the Community towards a survey on the prevalence of *Salmonella* spp. and Methicillin-resistant *Staphylococcus aureus* in herds of breeding pigs to be carried out in the Member States (EC, 2008). The survey started on 1 January 2008 for a period of 12 months. The present report deals only with the survey regarding *Salmonella* spp.

TERMS OF REFERENCE AS PROVIDED BY THE EUROPEAN COMMISSION

The Commission requested EFSA, on 19 April 2006, to analyse the results of the baseline survey on *Salmonella* spp. in herds of breeding pigs, in particular:

- to estimate the prevalence of *Salmonella* spp. in herds of breeding pigs in Member States and at level of the European Union,
- to assess quantitatively the risk factors for *Salmonella* spp. in herds of breeding pigs based on the information collected.

The present report part A should provide comparable prevalence estimates of *Salmonella* spp. in herds of breeding pigs across Member States.

ANALYSIS

1. Introduction

This report (part A) describes the results of a baseline survey carried out in the European Union (EU) to estimate the prevalence of *Salmonella* spp. (*Salmonella*) in holdings with breeding pigs. The survey was the fifth in a series of baseline surveys of *Salmonella* carried out within the EU. The objective of the surveys has been to obtain comparable data for all MSs through harmonised sampling schemes. According to Regulation (EC) No 2160/2003 on the control of *Salmonella* and other zoonotic agents (EC, 2003b), which aims to reduce the incidence of food-borne diseases in the EU, results of such a survey will inform the setting of the Community target for the reduction of the prevalence of the infection in breeding herds of pigs. The part B report on the analyses of the baseline survey on the prevalence of *Salmonella* in holdings with breeding pigs will present the analyses of risk factors associated with occurrence of *Salmonella* in the holdings and the analyses of the serovar distribution. The Part B report will be published at a later date.

The target population was holdings constituting at least 80% of the breeding pig population in a MS and included in most MSs two sub-target populations: breeding holdings and production holdings (with breeding pigs). Breeding holdings sell a proportion of gilts or boars for breeding purposes, while the remainder is sold for slaughter. Production holdings mainly sell pigs for fattening or provide directly slaughter pigs to the slaughterhouse. Production holdings may be of farrow-to-weaner, farrow-to-grower or farrow-to-finish types. The weaner-to-finish and finisher pig holdings were not targeted by this survey. Figure 1 shows the pyramidal structure of the primary pig production sector and shows the breeding and production holding types included in the survey. Detailed definitions of the different types of pig holdings are given in the glossary.

The two types of holdings housing breeding pigs (breeding holdings and production holdings) are usually distinct entities (EFSA, 2007b). They are likely to differ in terms of management and hygiene practices, pig health status, and biosecurity measures in place. Breeding holdings have in general a better status with regard to these aspects. In addition, breeding holdings provide breeding pigs to production holdings and may thus disseminate *Salmonella*. Therefore, separate investigations of the situation in breeding holdings and production holdings are meaningful. In the remainder of the report these two types of holdings with breeding pigs will be referred to as 'breeding holdings' and 'production holdings'.

Twenty-four EU Member States (MSs) participated in the survey whereas Greece, Malta and Romania did not carry out the survey. In addition, two countries not belonging to the EU, Norway and Switzerland (later referred to as non-MSs) participated in the survey.

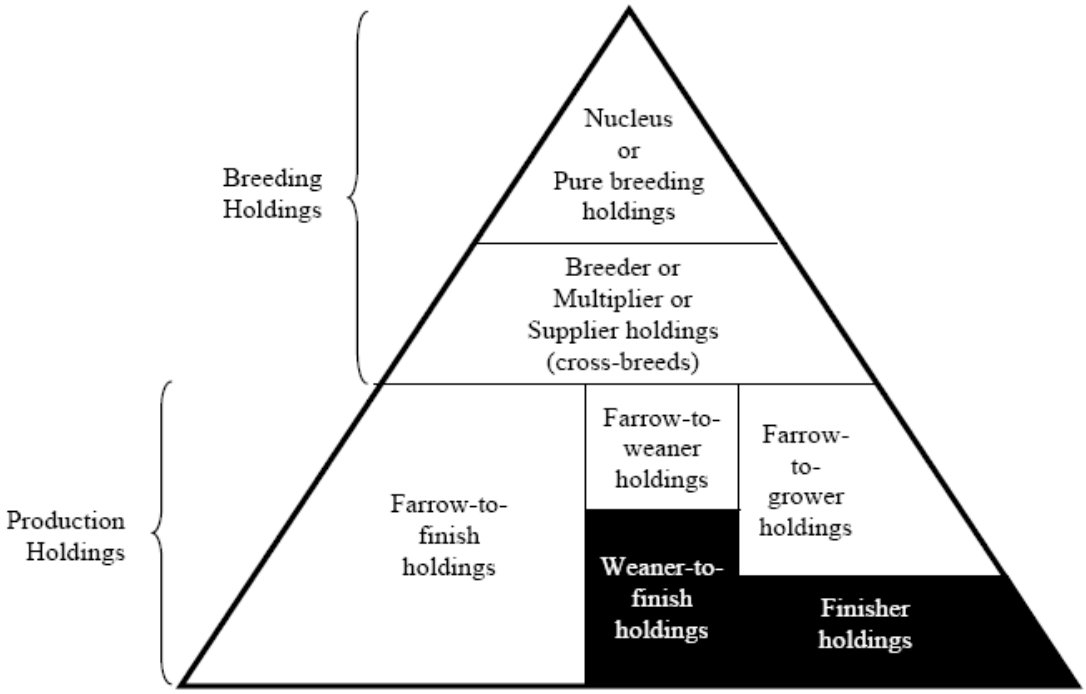

Figure 1 Overview of the pig breeding and production holdings included in the EU *Salmonella* baseline survey, 2008. Weaner-to-finish and finisher holdings were not covered by the survey[4].

2. Objectives

The aim of the survey was to provide comparable prevalence estimates of *Salmonella* in holdings with breeding pigs for supporting the setting of EU *Salmonella* reduction targets.

The specific objectives were:

- to estimate the prevalence of *Salmonella*-positive holdings with breeding pigs at EU level and for each MS individually;
- to investigate the effects of factors potentially associated with the occurrence of *Salmonella* in holdings with breeding pigs; and
- to investigate the *Salmonella* serovar distribution and determine the most frequently occurring serovars in breeding pigs across the EU.

This part A report includes the analyses of the prevalence of *Salmonella* and presents the most frequent serovars. The analyses of potential factors associated with the occurrence of *Salmonella*, as well as more in-depth analyses of the serovar and phage type distribution, will be provided in the part B report.

[4] See Glossary for definitions.

3. Materials and Methods

A detailed description of the design of the baseline survey, sampling design, sample size and bacteriological testing is found in Annex I of the Commission Decision 2008/55/EC of the 20 December 2007 (EC, 2008).

In this report the term pig 'holding' is used instead of pig 'herd'. This is because the epidemiological unit that was sampled was the pig holding. Also, a pig holding is well defined in the EU Regulations and all pig holdings must have a unique identity with a unique geographic location. Moreover, the definition of a herd may vary in different MSs (EFSA, 2007b).

3.1. Survey design

The survey targeted a population of holdings that together constituted at least 80% of the breeding pig population in a MS. This was to be achieved by including, preferentially, holdings housing at least 50 breeding pigs. A breeding pig is defined as a pig (sow or boar) of at least six months of age kept for breeding purposes. Whenever the selected holdings with at least 50 breeding pigs did not contain together 80% of the national herd of breeding pigs, smaller holdings with less than 50 breeding pigs were also sampled. A detailed description of the populations of breeding and production holdings in the EU in 2008 was reported by the participating countries (Appendix A). In each MS, holdings to be sampled were randomly selected from the breeding holdings and production holdings group. However, some countries used a stratified approach where holdings were selected according to the size of the holdings and/or to the proportion of eligible holdings within each administrative region.

In each selected breeding and production holding, samples were collected from 10 randomly chosen pens, yards or groups of breeding pigs over six months of age. The number of pens, yards or groups to be sampled was proportionally allocated according to the number of breeding pigs over six months of age, representing the different stages of production of the breeding herd (maiden gilts, pregnant pigs, farrowing and lactating pigs, pigs in the service area, or mixed). One pooled faecal sample was collected from each of the 10 selected pens, yards or groups of breeding pigs. At least 10 individual breeding pigs contributed to each pooled sample.

The material collected for bacteriological analysis was freshly voided faeces representing the whole breeding section of the holding, which is the unit of interest. Samples were taken by the competent authority in each MS or under its supervision and were tested by the National Reference Laboratory (NRL) (or an authorised laboratory) using the latest ISO 6579 Annex D method (ISO, 2007). MSs were also invited to submit additional information on *S.* Enteritidis and *S.* Typhimurium phage types and antimicrobial susceptibility of *Salmonella* isolates, but this testing was not a compulsory requirement of the survey.

3.2. Data collection and validation

A set of data exclusion criteria (Appendix B) was used by the European Commission (EC) and EFSA to identify and exclude non-valid and non-plausible information in the *Salmonella* dataset submitted by MSs during the survey period and MSs corrected those excluded data. However, data of four countries with sampled holdings in non-compliance with the exclusion criterion 2 (holding having at least one of the pooled faecal samples originating from a pen with less than 10 pigs), were not excluded because only few holdings were affected and because these four countries' prevalences of *Salmonella*–positive holdings with breeding pigs as estimated on the basis of two datasets, one comprising these holdings and one excluding these holdings, were not statistically different.

The final validated dataset comprised 5,117 holdings with breeding pigs in 24 MSs, and in two non-MSs (final dataset), which formed the basis for all subsequent analyses. No data was submitted by Greece, Malta or Romania. EFSA received the validated dataset from the EC on 24 June 2009. An overview of the validated dataset at holding level is given in Table 1.

Table 1 Overview of the final validated dataset at holding level including the number of holdings, pens and samples included in the *Salmonella* EU baseline survey, 2008[(a)]

Country	Number of breeding holdings	Number of production holdings	Total number of holdings with breeding pigs	Total number of pens	Total number of samples
Austria	79	173	252	2,520	2,520
Belgium	16	209	225	1,657	2,250
Bulgaria	47	25	72	720	720
Cyprus	4	60	64	640	640
Czech Republic	106	161	267	2,670	2,670
Denmark	95	198	293	2,930	2,930
Estonia	6	28	34	340	340
Finland	50	157	207	1,629	2,070
France	157	186	343	3,430	3,430
Germany	46	155	201	2,010	2,010
Hungary	40	141	181	1,809	1,810
Ireland	40	149	189	1,890	1,890
Italy	43	171	214	2,140	2,140
Latvia	5	28	33	330	330
Lithuania	10	72	82	820	820
Luxembourg	3	41	44	440	440
Netherlands	109	212	321	3,210	3,210
Poland	144	178	322	3,220	3,220
Portugal	33	134	167	1,592	1,670
Slovakia	96	96	192	1,920	1,920
Slovenia	27	87	114	625	1,140
Spain	150	209	359	3,590	3,590
Sweden	57	150	207	1,694	2,070
United Kingdom	67	191	258	2,365	2,580
EU Total (24 MSs)	1,430	3,211	4,641	44,191	46,410
Norway	108	143	251	2,510	2,510
Switzerland	71	154	225	2,250	2,250

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

3.3. Statistical analysis

3.3.1. Descriptive analysis

A comparison between the survey protocol and the collected sample in terms of sample size, stratification by month and time elapsed between sampling and testing, was carried out using frequency tables and graphs.

3.3.2. Estimating the observed prevalence of *Salmonella*-positive holdings

Data on breeding holdings and production holdings were analysed separately, and the following four outcomes were considered for both types of holding:

a) positivity for *Salmonella*;
b) positivity for *Salmonella* Typhimurium (*S.* Typhimurium);
c) positivity for *Salmonella* Derby (*S.* Derby); and
d) positivity for serovars other than *S.* Typhimurium and/or *S.* Derby.

Depending on the outcome of interest, a holding was considered positive if *Salmonella*, *S.* Typhimurium, *S.* Derby or other serovars were detected in at least one of the 10 pooled faeces samples, and negative otherwise.

Prevalence was estimated for each MS through the breeding/production holding positivity ratio (proportion of test positive holdings out of the total number of holdings tested). All the data, including those from holdings with less than 50 breeding pigs, are included in the estimation of MS level prevalence.

At EU level, the prevalence was estimated using only the data from pig holdings with at least 50 breeding pigs. This approach was taken because the survey targeted holdings with at least 50 breeding pigs. Holdings with less than 50 breeding pigs were only to be sampled in those MSs that did not have a sufficient number of pig holdings to cover the sample size needed, which was only the case in a few MSs. At EU level, the proportion of sampled holdings with less than 50 breeding pigs was small (3% and 5% of the breeding and production holdings sampled, respectively). In addition, data on the total number of small holdings was not available from some MSs. Furthermore, including small holdings in the estimation of the EU prevalence, would have meant extrapolating findings chiefly derived from big holdings to a large number of small holdings in the EU, while a very limited number of those small holdings were sampled. Making such an extrapolation would assume that the risk of *Salmonella* infection is the same in small and big holdings, and there is no information currently available to justify this assumption.

In the estimation of the EU prevalence, MSs were considered as strata and the proportion of sampled breeding/production holdings, i.e. the sampling fraction, was not constant across MSs. The sampling fraction was the number of sampled breeding/production holdings with at least 50 breeding pigs in a MS divided by the total number of breeding/production holdings with at least 50 breeding pigs in the same MS. These sampling fractions were used to account for unequal (or disproportionate) proportions of sampled breeding/production holdings among MSs while estimating the EU level prevalence as a weighted mean of MSs' prevalences (see formula (1) or (2) in Appendix C). To this end each MS' prevalence was weighted by the reciprocal of the sampling fraction for breeding/production holdings, the reciprocal being the total number of breeding/production holdings with at least 50 breeding pigs in a MS divided by the number of sampled breeding/production holdings with at least 50 breeding pigs in the same MS. If the number of holdings in the sample was larger than the number of holdings reported by the country, the sampling fraction was assumed to be one (i.e. 100%).

This report presents estimates observed prevalence at MS level and EU level, which does not account for test misclassification bias, i.e. imperfect sensitivity or specificity of the test. A finite population correction was used to calculate a 95% Confidence Interval (CI) for prevalence estimates at MS and EU level. More details on statistical approach and weighting are given in Appendix C.

Factors such as the number of days between the sampling date and testing date at the laboratory and the month of sampling were considered to be potentially related to the sensitivity of the sampling and testing scheme and may therefore have an impact on the probability of detecting *Salmonella* in the samples. To investigate any such potential impact, both logistic regression models predicting holding positivity as a function of country and respectively, the days between testing and sampling and the month of sampling, were fitted separately for breeding holdings and production holdings. In case of a significant impact, further regression analyses were warranted to eventually investigate the estimation of adjusted prevalence figures.

4. Results

4.1. Overview of the 2008 populations of breeding and production holdings in the EU

An overview of the populations of breeding holdings and production holdings in the EU, stratified by the number of breeding pigs (more or less than 50 breeding pigs per holding), is presented, as reported by MSs and non-MSs in Appendix A (Table 6, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14). The EU population of breeding holdings with at least 50 breeding pigs totalled 4,727 holdings in 2008. Poland had the highest number of such breeding holdings and accounted for 29.6% of the EU population. Conversely, several MSs, as well as the non-MSs, had a very low number of breeding holdings. The EU population of production holdings with at least 50 breeding pigs totalled 54,157 holdings in 2008. The largest populations were in Spain and Germany, representing 45% of those pig holdings. Conversely, several MSs had a very low number of such production holdings. These MS-specific figures of 'total numbers of breeding/production holdings with at least 50 breeding pigs' impact on the estimation of the EU prevalence as explained in section 3.3.2., because they determine, together with the sampled number of breeding/production holdings, the weight attributed to each MS prevalence.

4.2. Sample summary statistics and protocol-sample comparison

The cleaned validated dataset (Table 1) comprised data on 1,430 breeding holdings and 3,211 production holdings with breeding pigs originating from 24 MSs. The number of breeding holdings included in the survey varied from three in Luxembourg up to 157 in France, whereas the number of production holdings investigated ranged between 25 in Bulgaria and 212 in the Netherlands. The dataset also included data from the two non-MSs, Norway and Switzerland, with 108 and 71 breeding holdings, and 143 and 154 production holdings, respectively.

A total of nine MSs and Norway reported the results of sampling on breeding holdings with less than 50 breeding pigs, while a total of 15 MSs and Norway sampled production holdings with less than 50 breeding pigs. The sampling fractions (proportion (%) of sampled holdings out of the existing holdings) and the sampled holding weights (detailed for breeding holdings and production holdings, with at least 50 breeding pigs), used to compute the EU level prevalence, are presented in Appendix D. For breeding holdings, the median sampling fraction was 62.5% and sampling fractions ranged from one in Bulgaria, Cyprus, Hungary, Luxembourg, Slovakia and Slovenia (all breeding holdings with at least 50 breeding pigs sampled) to 0.06 and 0.09 in Belgium and Poland, respectively. For these two latter MSs this means that 6% and 9% of the breeding holdings with at least 50 breeding pigs were sampled, respectively. This resulted in the application of heavy weights to the positive holdings in these two MSs when estimating EU prevalence. For production holdings, the median sampling fraction was 16.5% and sampling fractions ranged from one in Estonia and Luxembourg (all

production holdings with at least 50 breeding pigs sampled) to 0.02 in Spain and 0.01 in Germany (meaning that 2% and 1% of the production holdings with at least 50 breeding pigs were sampled, respectively). Again, this resulted in heavy weights being given to the positive holdings of those MSs with small sampling fractions when estimating EU prevalence.

The results of the descriptive analysis are presented in Appendix E. A summary of these results is presented here.

The distribution of the number of holdings included in the survey by the month of sampling is shown for breeding holdings and production holdings (Appendix E: Figure 15 and Figure 16, Table 7 and Table 8). Sampling appeared to be evenly distributed over the year in most participating countries, although there was an increase in the number of production holdings sampled during the last three months of the survey. Portugal performed the entire survey during the last two months of the survey period.

The distribution of the number of holdings by the holding size is presented for breeding holdings and production holdings (Appendix E: Figure 17 and Figure 18, Table 9, and Table 10). Overall, at EU level, about 65% of the breeding holdings and production holdings with breeding pigs housed between 100 and 999 breeding pigs.

The distribution of the number of pooled samples by the number of days between sampling and testing for *Salmonella* is displayed for holdings with breeding pigs (Appendix E: Figure 19 and Table 11). This distribution is unimodal, i.e. has a single peak, at EU level: a mode occurs at one day after sampling.

4.3. Prevalence of *Salmonella*-positive holdings with breeding pigs

In this survey, the EU prevalence of *Salmonella*-positive holdings with breeding pigs (all holdings, including both breeding and production holdings) with at least 50 breeding pigs was 31.8% (95% CI: 30.0; 33.7). This means that approximately one in three holdings with breeding pigs was positive for *Salmonella*. The EU prevalence of holdings with breeding pigs positive to the other *Salmonella* serovars or groups of serovars was:

- for *Salmonella* Typhimurium : 7.0% (95% CI: 5.9; 8.0)
- for *Salmonella* Derby : 9.0% (95% CI: 7.9; 10.1)
- for serovars other than *S.* Typhimurium and/or Derby : 19.8% (95% CI: 18.3; 21.3)

One MS (Finland) and the non-MS (Norway) did not detect any *Salmonella* in their surveyed holdings.

4.3.1. Prevalence of *Salmonella*-positive breeding holdings

The prevalence of *Salmonella*-positive breeding holdings in each MS and at EU level as well as in non-MSs is presented in Table 2.

In Appendix F, the number and the proportions (%) of positive breeding holdings, i.e. the number of positive breeding holdings out of the total number of sampled holdings, for each of the *Salmonella* outcomes is shown both at MS specific and at the EU level.

Based on initial single variable regression analysis, no significant effect was detected of the month of sampling and the delay between sampling and testing on the probability of detection of *Salmonella* in a breeding holding. Consequently only non-adjusted prevalence estimates are reported.

4.3.1.1. Prevalence of *Salmonella*-positive breeding holdings

Salmonella was detected in 20 out of the 24 MSs providing data on breeding holding status (Figure 2). In four MSs (Estonia, Finland, Lithuania and Slovenia) and in one non-MS (Norway), no sampled breeding holding tested positive. At MS level, the prevalence was highest in Spain (64.0%) and The Netherlands (57.8%). EU prevalence was 28.7% (95% CI: 26.3; 31.0). Figure 3 displays the geographic distribution of the prevalence of *Salmonella*-positive breeding holdings in MSs and other participating countries.

4.3.1.2. Prevalence of *Salmonella* Typhimurium-positive breeding holdings

Salmonella Typhimurium was detected in 16 out of the 24 MSs providing data on breeding holding status (Figure 4). At MS level, the prevalence was highest in the United Kingdom (19.4%) and Ireland (17.5%). EU prevalence was 7.8% (95% CI: 6.1; 9.5). Figure 22 in Appendix G displays the geographic distribution of the prevalence of *Salmonella* Typhimurium-positive breeding holdings in MSs and other participating countries.

4.3.1.3. Prevalence of *Salmonella* Derby-positive breeding holdings

Salmonella Derby was detected in 17 out of the 24 MSs providing data on breeding holding status (Figure 5). At MS level, prevalence was highest in France (25.5%) and Cyprus (25.0%). The EU prevalence was 8.9% (95% CI: 7.4; 10.5). Figure 23 in Appendix G displays the geographic distribution of the prevalence of *Salmonella* Derby-positive breeding holdings in MSs and other participating countries.

4.3.1.4. Prevalence of breeding holdings positive to serovars other than *Salmonella* Typhimurium or Derby

Salmonella serovars other than *Salmonella* Typhimurium or Derby were detected in 19 out of the 24 MSs providing data on breeding holding status (Figure 24 in Appendix G). At MS level, prevalence was highest in Spain (53.3%) and the Netherlands (38.5%). EU prevalence was 15.9% (95% CI: 14.2; 17.6). Figure 25 in Appendix G displays the geographic distribution of the prevalence of breeding holdings positive to serovars other than *Salmonella* Typhimurium or Derby in MSs and other participating countries.

Table 2 Prevalence of *Salmonella*-positive breeding holdings[a], *Salmonella* EU baseline survey, 2008[b].

Member State	N[c]	*Salmonella*		*S.* Typhimurium		*S.* Derby		*Salmonella* other than *S.* Typhimurium and/or *S.* Derby[d]	
		% prev.	95%CI[e]	% prev.	95%CI	% prev.	95%CI	% prev.	95%CI
Austria	79	6.3	3.2-13.2	3.8	1.8-10.0	1.3	0.4-6.0	1.3	0.4-6.0
Belgium	16	18.8	7.3-45.1	12.5	4.2-37.8	6.3	1.4-29.7	6.3	1.4-29.7
Bulgaria	47	2.1	1.6-8.2	0	0.0-4.9	0	0.0-4.9	2.1	1.6-8.2
Cyprus	4	50.0	50.0-50.0	0	0.0-0.0	25.0	25.0-25.0	25.0	25.0-25.0
Czech Republic	106	10.4	7.2-15.9	3.8	2.1-7.7	0.9	0.5-4.1	5.7	3.6-10.3
Denmark	95	41.1	34.4-48.9	15.8	11.3-22.6	12.6	9.1-18.8	17.9	13.4-24.7
Estonia	6	0	0.0-14.3	0	0.0-14.3	0	0.0-14.3	0	0.0-14.3
Finland	50	0	0.0-6.1	0	0.0-6.1	0	0.0-6.1	0	0.0-6.1
France	157	50.3	44.2-57.1	7.0	4.5-11.4	25.5	20.5-31.7	26.8	21.8-33.2
Germany	46	28.3	18.4-42.6	8.7	3.9-20.3	10.9	5.3-22.9	6.5	2.6-17.4
Hungary	40	30.0	30.0-30.0	10.0	10.0-10.0	7.5	7.5-7.5	15.0	15.0-15.0
Ireland	40	52.5	51.2-53.7	17.5	17.1-19.5	20.0	19.5-22.0	17.5	17.1-19.5
Italy	43	51.2	39.2-65.1	7.0	2.7-17.7	16.3	9.1-29.0	16.3	9.1-29.0
Latvia	5	20.0	14.3-42.9	0	0.0-28.6	20.0	14.3-42.9	20.0	14.3-42.9
Lithuania	10	0	0.0-9.1	0	0.0-9.1	0	0.0-9.1	0	0.0-9.1
Luxembourg	3	33.3	33.3-33.3	0	0.0-0.0	0	0.0-0.0	33.3	33.3-33.3
Netherlands	109	57.8	50.0-66.2	13.8	9.3-20.9	18.3	12.9-26.1	38.5	31.3-47.2
Poland	144	6.9	3.9-12.3	2.8	1.1-6.9	1.4	0.4-4.9	3.5	1.6-7.9
Portugal	33	45.5	38.5-53.8	9.1	7.7-17.9	9.1	7.7-17.9	33.3	28.2-43.6
Slovakia	96	11.5	9.0-16.4	2.1	1.5-5.2	3.1	2.2-6.7	6.3	4.5-10.4
Slovenia	27	0	0.0-9.1	0	0.0-9.1	0	0.0-9.1	0	0.0-9.1
Spain	150	64.0	57.8-70.4	14.0	10.4-19.5	10.0	7.0-14.9	53.3	47.2-60.0
Sweden	57	1.8	1.3-6.3	1.8	1.3-6.3	0	0.0-3.8	0	0.0-3.8
United Kingdom	67	52.2	44.6-61.5	19.4	13.8-27.7	14.9	10.0-23.1	29.9	23.1-39.2
European Union	1,377[f]	28.7	26.3-31.0	7.8	6.1-9.5	8.9	7.4-10.5	15.9	14.2-17.6
Norway	108	0	0.0-2.2	0	0.0-2.2	0	0.0-2.2	0	0.0-2.2
Switzerland	71	15.5	12.6-20.7	4.2	3.4-8.0	1.4	1.1-4.6	8.5	6.6-13.8

(a): One holding can be positive for more than one serovar.

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

(c): N is the total number of sampled holdings in each country.

(d): Untypeable *Salmonella* strains, as well as the partially typed *Salmonella* strains "4,5,12:i:-", "4,12:i:-", "4,5,12:-:-", were not included in the outcome "*Salmonella* other than *S.* Typhimurium and *S.* Derby". Instead, untypeable, partially typed, and non-typed *Salmonella* isolates were only included in the outcome variable "*Salmonella*".

(e): 95% CI based on a finite population approach.

(f): Total number of breeding holdings with at least 50 breeding pigs sampled in the EU.

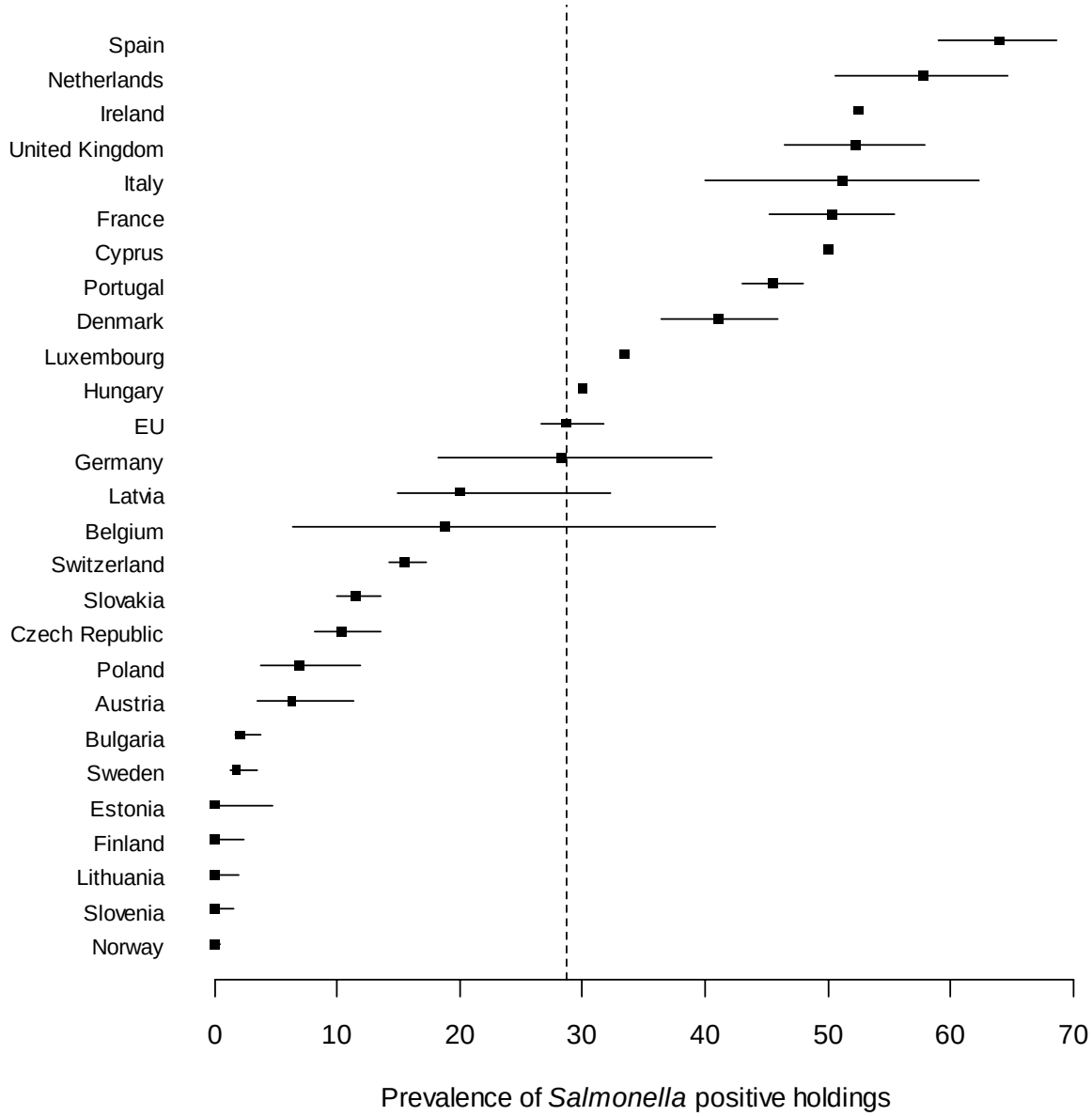

Figure 2 Prevalence[(a)] of *Salmonella*-positive breeding holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing breeding holdings are included in the survey in Cyprus, Hungary, and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

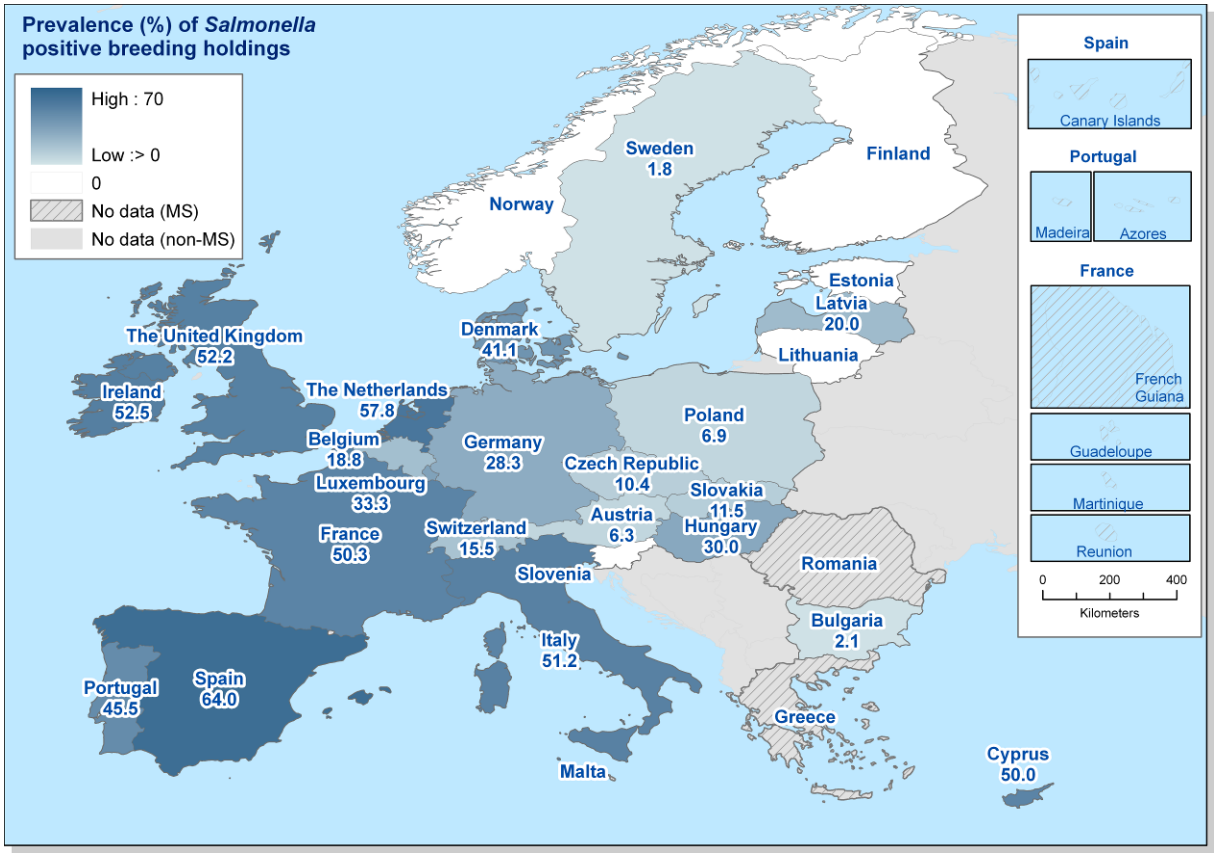

Figure 3 Prevalence of *Salmonella*-positive breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

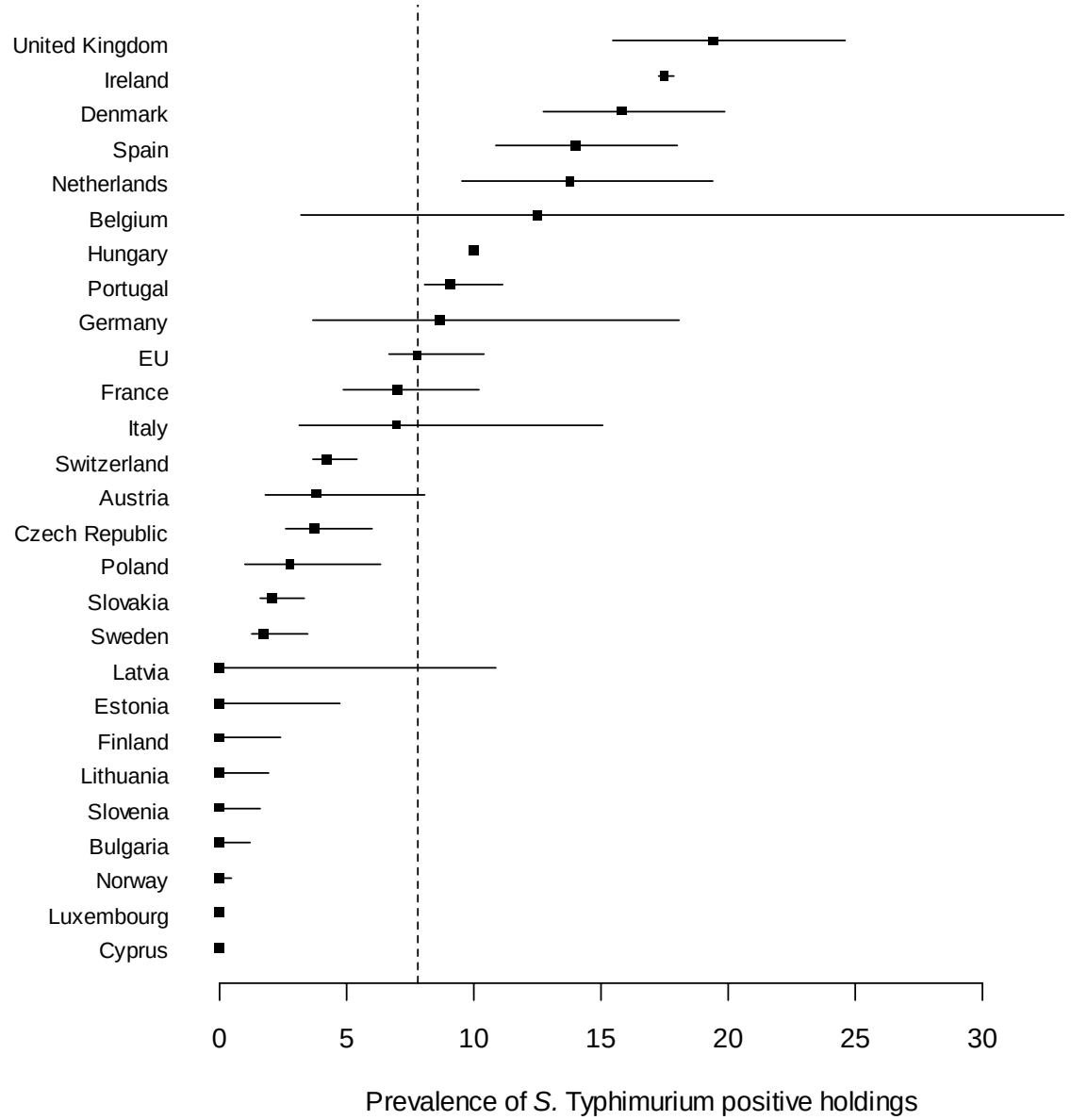

Figure 4 Prevalence[(a)] of *Salmonella* Typhimurium-positive breeding holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing breeding holdings are included in the survey in Cyprus, Hungary, and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

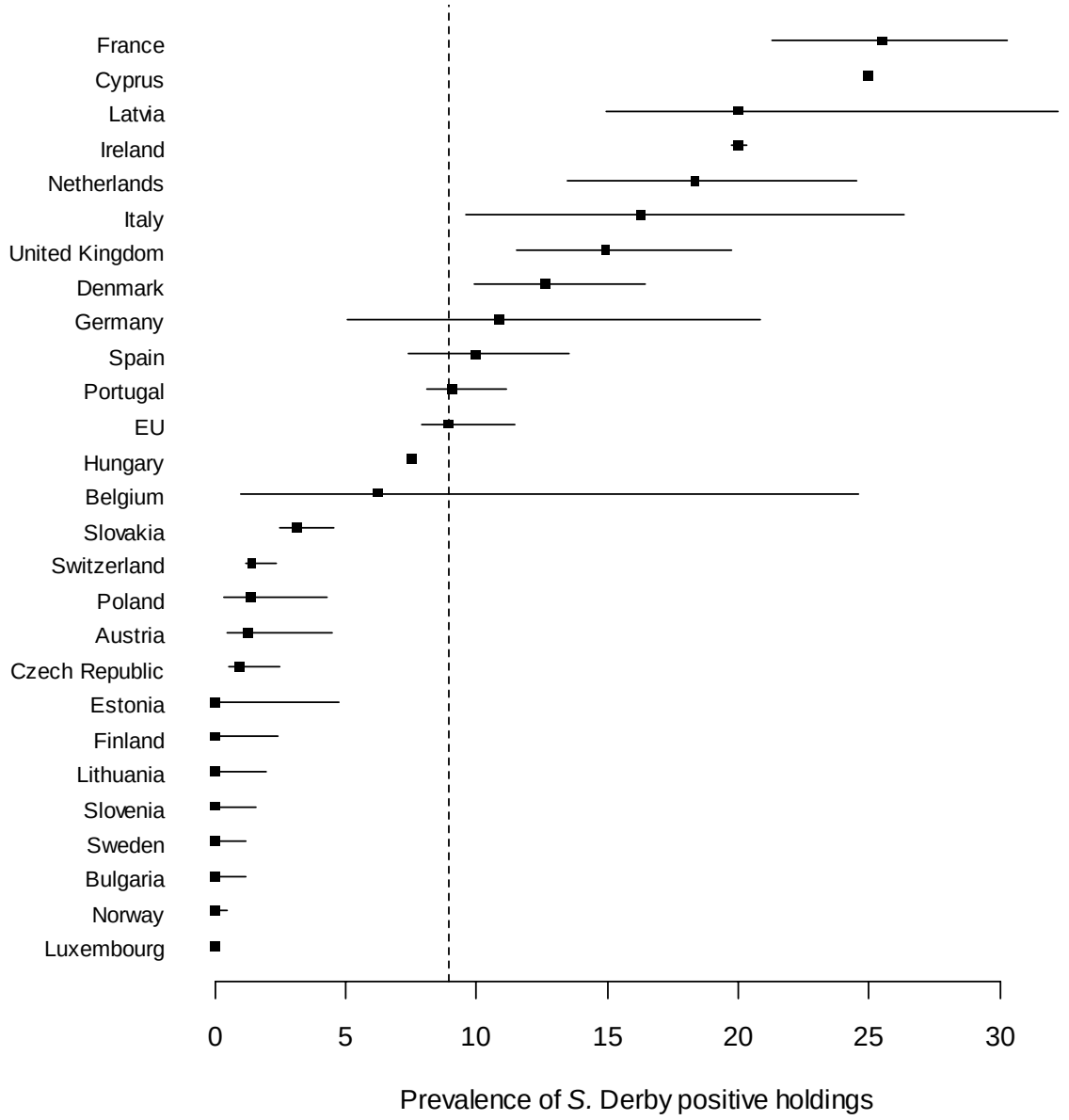

Figure 5 Prevalence[(a)] of *Salmonella* Derby-positive breeding holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing breeding holdings are included in the survey in Cyprus, Hungary, and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

4.3.2. Prevalence of *Salmonella*-positive production holdings

The prevalence of *Salmonella*-positive production holdings in each MS and at EU level as well as in non-MSs are presented in Table 3.

In Appendix F, the number and the proportions (%) of positive production holdings, i.e. the number of positive production holdings out of the total number of sampled holdings, for each of the *Salmonella* outcomes is shown both at MS specific and at EU level.

Based on initial single variable regression analysis, no significant effect was detected of the month of sampling and the delay between sampling and testing on the probability of detection of *Salmonella* in a production holding. Consequently only non-adjusted prevalence estimates are reported.

4.3.2.1. Prevalence of *Salmonella*-positive production holdings

Salmonella was detected in 21 out of the 24 MSs providing data on production holding status (Figure 6). In three MSs (Bulgaria, Finland and Sweden) and in one non-MS (Norway), no sampled breeding holding tested positive. At MS level, the prevalence was highest in the Netherlands (55.7%) and Spain (53.1%). EU prevalence was 33.3% (95% CI: 30.9; 35.7). Figure 7 displays the geographic distribution of the prevalence of *Salmonella*-positive production holdings in MSs and other participating countries.

4.3.2.2. Prevalence of *Salmonella* Typhimurium-positive production holdings

Salmonella Typhimurium was detected in 15 out of the 24 MSs providing data on production holding status (Figure 8). At MS level, the prevalence was highest in Ireland (17.4%) and Portugal (13.4%). EU prevalence was 6.6% (95% CI: 5.3; 7.9). Figure 26 in Appendix H displays the geographic distribution of the prevalence of *Salmonella* Typhimurium-positive production holdings in MSs and other participating countries.

4.3.2.3. Prevalence of *Salmonella* Derby-positive production holdings

Salmonella Derby was detected in 19 out of the 24 MSs providing data on production holding status (Figure 9). At MS level, the prevalence was highest in France (20.4%) and Luxembourg (17.1%). EU prevalence was 9.0% (95% CI: 7.6; 10.5). Figure 27 in Appendix H displays the geographic distribution of the prevalence of *Salmonella* Derby-positive production holdings in MSs and other participating countries.

4.3.2.4. Prevalence of production holdings positive for serovars other than *Salmonella* Typhimurium or Derby

Salmonella serovars other than *Salmonella* Typhimurium or Derby were detected in 20 out of the 24 MSs providing data on production holding status (Figure 28 in Appendix H). At MS level, prevalence was highest in Spain (42.6%) and the Netherlands (42.5%). EU prevalence was 21.6% (95% CI: 19.5; 23.6). Figure 29 in Appendix H displays the geographic distribution of the prevalence of production holdings positive to serovars other than *Salmonella* Typhimurium or Derby in MSs and other participating countries.

Table 3 Prevalence of *Salmonella*-positive production holdings[a], *Salmonella* EU baseline survey, 2008[b]

Member State	N[c]	*Salmonella*		*S.* Typhimurium		*S.* Derby		*Salmonella* other than *S.* Typhimurium and/or *S.* Derby[d]	
		% prev.	95%CI[e]	% prev.	95%CI	% prev.	95%CI	% prev.	95%CI
Austria	173	5.8	3.2-10.3	0	0.0-2.1	0.6	0.1-3.2	5.2	2.8-9.6
Belgium	209	36.4	30.5-43.1	11.0	7.6-15.9	10.0	6.8-14.8	21.5	16.7-27.6
Bulgaria	25	0	0.0-13.5	0	0.0-13.5	0	0.0-13.5	0	0.0-13.5
Cyprus	60	18.3	13.8-26.4	0	0.0-4.6	8.3	5.7-14.9	8.3	5.7-14.9
Czech Republic	161	15.5	10.9-21.9	2.5	1.0-6.1	3.7	1.8-7.8	11.2	7.4-17.0
Denmark	198	41.4	35.2-48.4	12.6	8.9-17.9	14.6	10.6-20.2	18.7	14.1-24.7
Estonia	28	3.6	3.6-3.6	0	0.0-0.0	0	0.0-0.0	0	0.0-0.0
Finland	157	0	0.0-2.1	0	0.0-2.1	0	0.0-2.1	0	0.0-2.1
France	186	38.7	32.2-46.0	3.2	1.5-6.9	20.4	15.4-26.9	19.9	14.9-26.3
Germany	155	20.6	15.2-27.8	3.2	1.4-7.3	8.4	5.0-13.9	9.0	5.5-14.7
Hungary	141	27.7	22.1-34.6	1.4	0.6-4.5	12.8	8.9-18.6	14.2	10.1-20.2
Ireland	149	47.7	42.3-53.8	17.4	13.8-22.6	13.4	10.2-18.4	26.2	21.6-32.1
Italy	171	43.9	36.9-51.5	5.8	3.3-10.4	12.3	8.3-18.1	11.7	7.8-17.4
Latvia	28	28.6	20.5-41.0	0	0.0-7.7	3.6	2.6-12.8	25.0	17.9-38.5
Lithuania	72	8.3	7.1-12.9	0	0.0-2.4	0	0.0-2.4	8.3	7.1-12.9
Luxembourg	41	22.0	22.0-22.0	2.4	2.4-2.4	17.1	17.1-17.1	7.3	7.3-7.3
Netherlands	212	55.7	49.4-62.2	8.0	5.2-12.4	17.0	12.8-22.5	42.5	36.4-49.2
Poland	178	9.6	6.1-14.8	1.7	0.6-4.8	2.8	1.2-6.4	5.1	2.7-9.4
Portugal	134	43.3	35.6-52.0	13.4	8.8-20.3	5.2	2.6-10.4	29.9	23.0-38.2
Slovakia	96	18.8	12.6-27.7	3.1	1.2-8.7	4.2	1.8-10.1	13.5	8.3-21.8
Slovenia	87	10.3	5.7-18.7	0	0.0-4.1	1.1	0.3-6.2	10.3	5.7-18.7
Spain	209	53.1	46.6-60.0	12.4	8.7-17.7	6.7	4.1-10.9	42.6	36.3-49.5
Sweden	150	0	0.0-2.4	0	0.0-2.4	0	0.0-2.4	0	0.0-2.4
United Kingdom	191	44.0	37.8-50.9	9.9	6.7-14.8	11.0	7.5-16.0	31.9	26.3-38.7
European Union	3,050[f]	33.3	30.9-35.7	6.6	5.3-7.9	9.0	7.6-10.5	21.6	19.5-23.6
Norway	143	0	0.0-2.5	0	0.0-2.5	0	0.0-2.5	0	0.0-2.5
Switzerland	154	11.7	7.9-17.3	1.9	0.7-5.2	1.9	0.7-5.2	7.8	4.9-12.8

(a): One holding can be positive for more than one serovar.

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

(c): N is the total number of sampled holdings in each country.

(d): Untypeable *Salmonella* strains, as well as the partially typed *Salmonella* strains "4,5,12:i:-", "4,12:i:-", "4,5,12:-:-", were not included in the outcome "*Salmonella* other that *S.* Typhimurium and *S.* Derby". Instead, untypeable, partially typed, and non-typed *Salmonella* isolates were only included in the outcome variable "*Salmonella*".

(e): 95% CI based on a finite population approach.

(f): Total number of breeding holdings with at least 50 breeding pigs sampled in the EU.

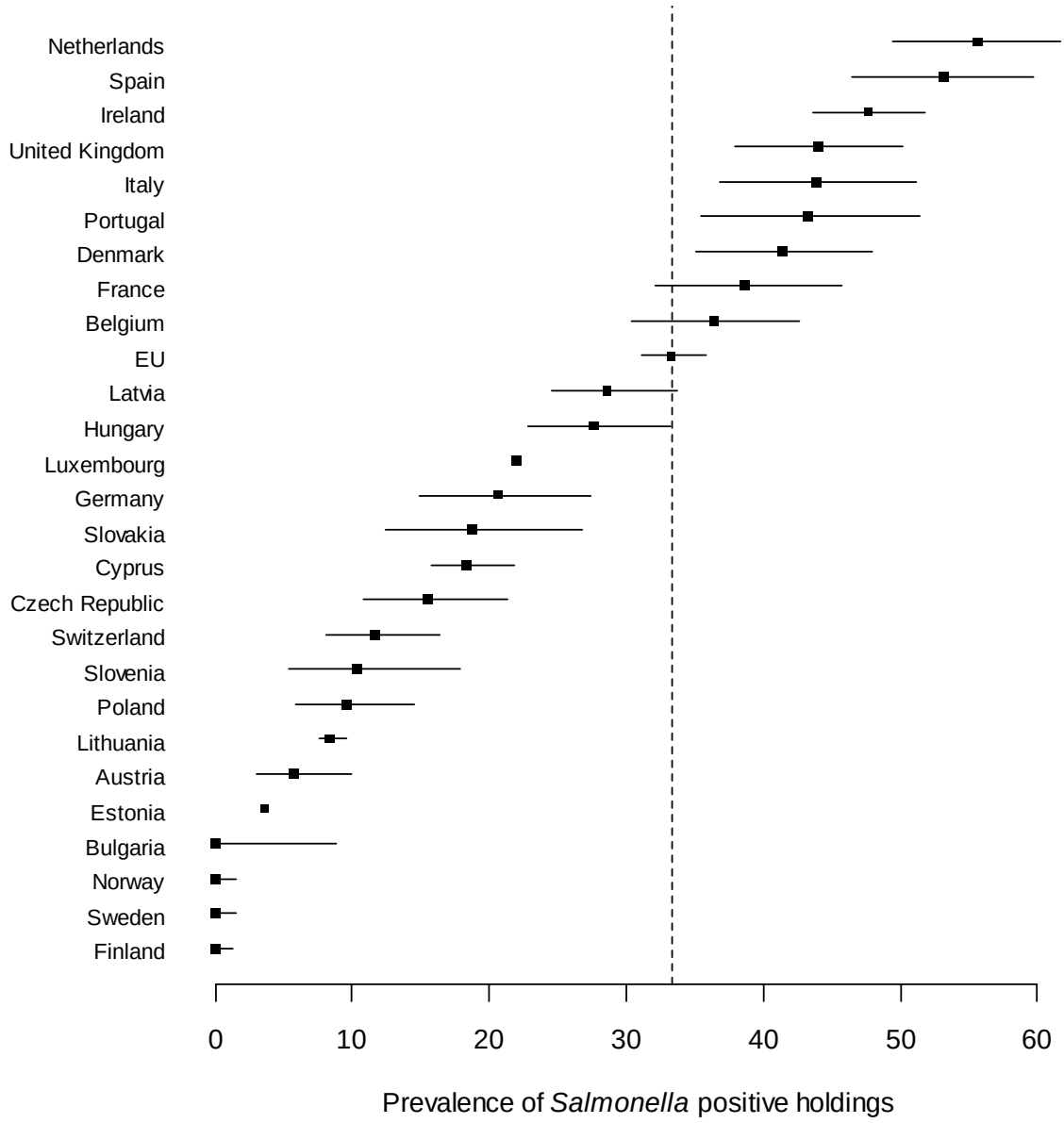

Figure 6 Prevalence[(a)] of *Salmonella*-positive production holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing production holdings are included in the survey in Estonia and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

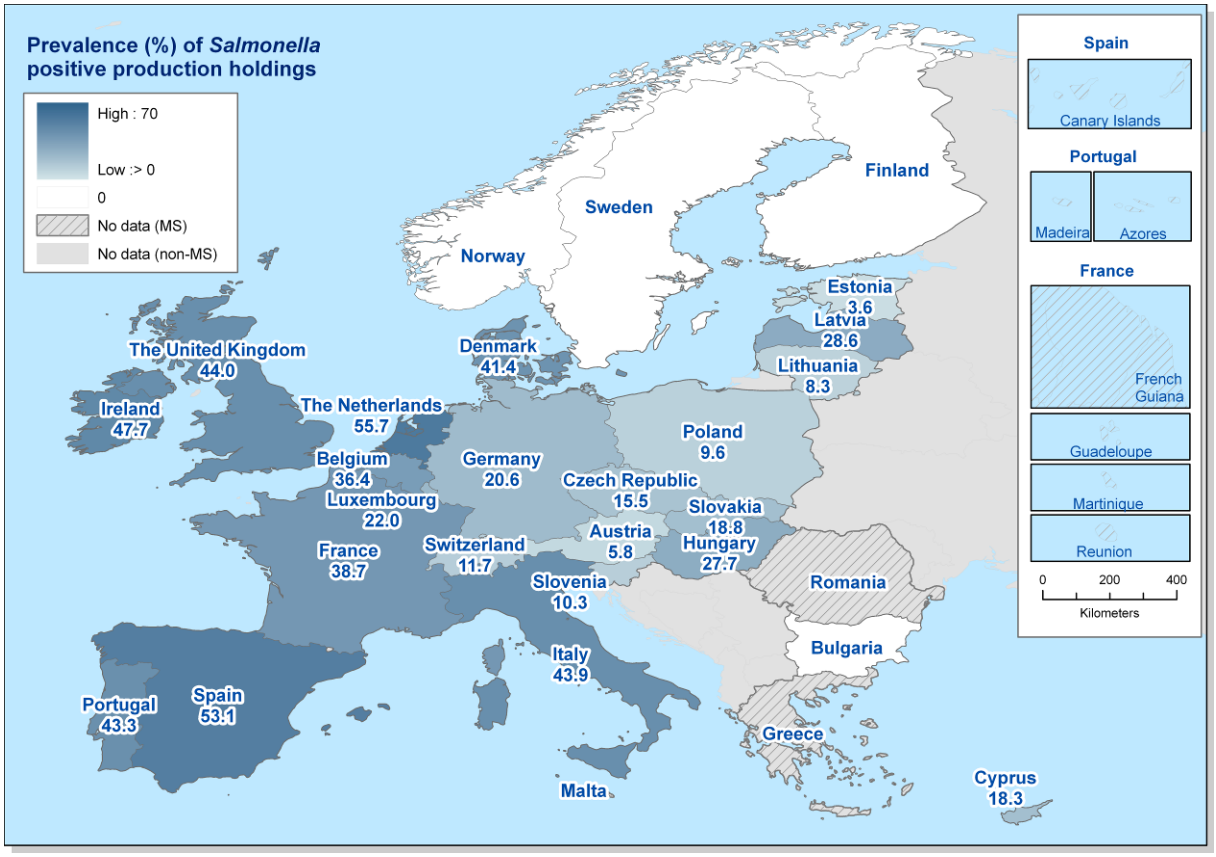

Figure 7 Prevalence of *Salmonella*-positive production holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

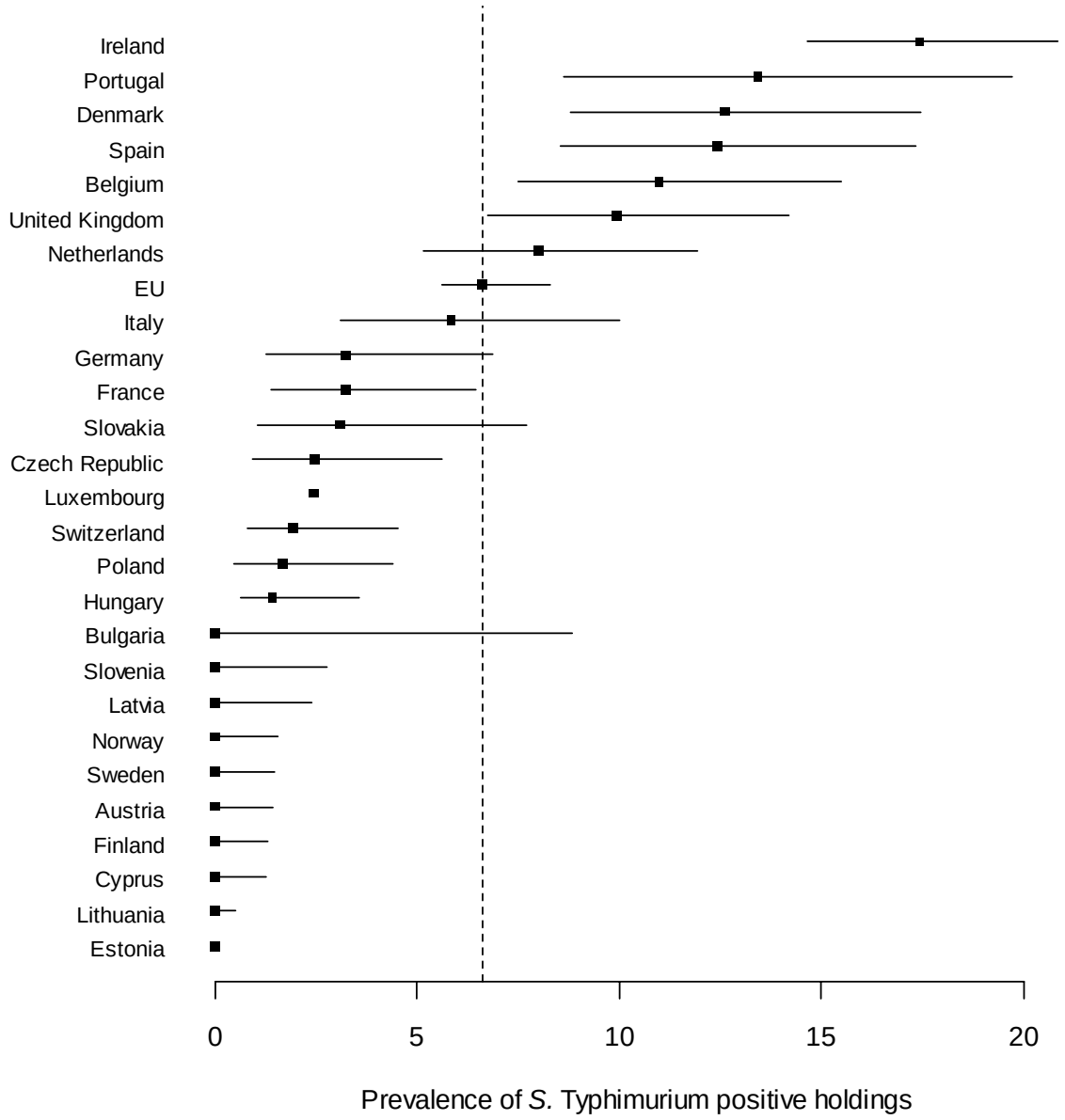

Figure 8 Prevalence[(a)] of *Salmonella* Typhimurium-positive production holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing production holdings are included in the survey in Estonia and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

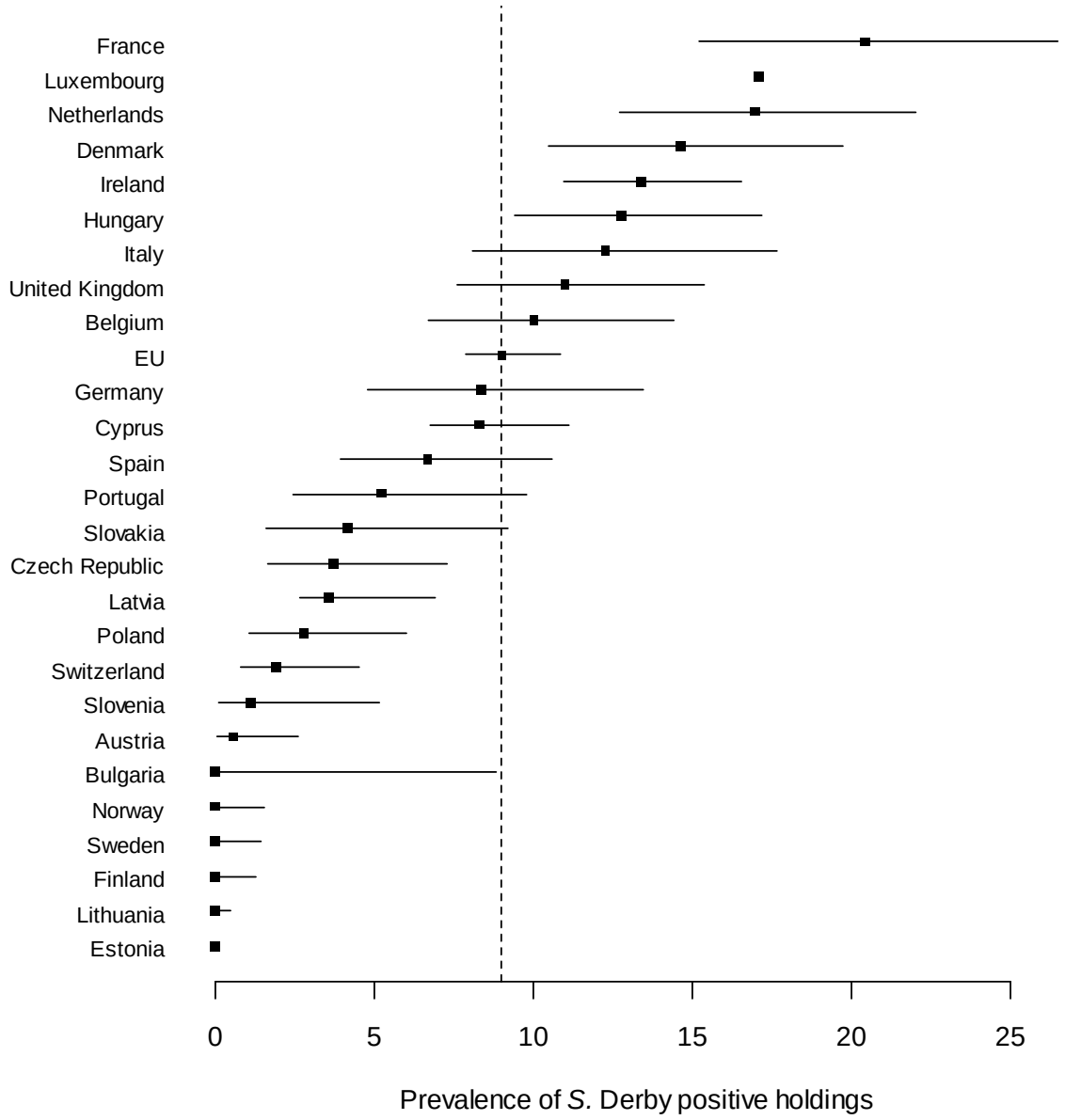

Figure 9 Prevalence[(a)] of *Salmonella* Derby-positive production holdings, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing production holdings are included in the survey in Estonia and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

4.4. Number of *Salmonella*-positive samples per holding

A total of 10 pooled faecal samples were taken from each holding, meaning that in *Salmonella*-positive holdings between one and 10 samples were positive. In Appendix F, the distribution of the within-holding number of *Salmonella*-positive pooled samples in positive holdings in each MS is shown in separately for breeding and production holdings (Figure 20 and Figure 21). This distribution of positive samples per holding varied among the MSs, indicating differences in the within-holding prevalence.

The overall proportions of *Salmonella*-positive breeding holdings found positive on the basis of one or two positive samples were 35% and 24%, respectively, and those found positive on the basis of three, four and five positive samples were all equal to nine percent. Finally, 14% of the *Salmonella*-positive breeding holdings in the EU were found positive on the basis of six or more (up to 10) *Salmonella*-positive samples.

The overall proportions of *Salmonella*-positive production holdings found positive on the basis of one, two, three, four and five positive samples were 34%, 21%, 16%, 11% and 6%, respectively. Finally, 12% of the *Salmonella*-positive production holdings in the EU were found positive on the basis of six or more (up to 10) *Salmonella*-positive samples.

The investigation of the average number of positive samples per holding type (breeding and production holdings), and the relation between the distribution of the within-holding number of *Salmonella*-positive samples and the within-holding prevalence of *Salmonella*-infected breeding pigs will be discussed more in detail in report part B.

4.5. Frequency distribution of *Salmonella* serovars

The serotyping of *Salmonella* isolates was mandatory according to the technical specifications of the survey. At least one isolate from each positive sample was to be typed according to the Kaufmann-White Scheme.

4.5.1. Frequency distribution of *Salmonella* serovars in breeding holdings

In total there were 1,303 *Salmonella* isolates originating from 452 *Salmonella*-positive breeding holdings in the survey. Two different *Salmonella* serovars were isolated from 99 *Salmonella*-positive breeding holdings. The frequency distribution of isolated *Salmonella* serovars in the EU and the one non-MS, ranked by the number of positive holdings, is listed in Table 4. Fifty-four different serovars were isolated from the faecal samples of breeding holdings across the EU. MS specific overviews of the frequency distribution of serovars are shown in Appendix I (Figure 30, Table 14).

S. Derby was the most frequently reported serovar in the EU and Switzerland, isolated in 29.6% of the *Salmonella*-positive breeding holdings. *S.* Derby was also the serovar most commonly isolated in terms of number of reporting countries: it was reported by 17 of the 20 MSs reporting *Salmonella*-positive breeding holdings and by Switzerland. The next most commonly reported serovar was *S.* Typhimurium, isolated from 25.4% of the *Salmonella*-positive breeding holdings and reported by 16 MSs and Switzerland. *S.* Infantis, *S.* Rissen and *S.* London were respectively the third, fourth and fifth most frequently isolated serovars and represented 7.7%, 7.3% and 6.4%, respectively, of the *Salmonella*-positive holdings. In contrast to *S.* Derby and *S.* Typhimurium that appeared to be widespread across MSs, the data on frequency distributions of *S.* Infantis, *S.* Rissen and *S.* London showed their occurrence in only a few MSs. *S.* Infantis was detected in seven MSs, in particular in France where it was the second most frequently isolated serovar and was detected in 24.1% of the *Salmonella*-positive breeding holdings. *S.* Rissen was isolated in five MSs, and was the most common serovar in Portugal and Spain where it was detected in 40% and 25% of the *Salmonella*-positive

breeding holdings, respectively. *S.* London was isolated in eight MSs and was the second and third most frequently recovered serovar in Portugal and Netherlands, respectively. *S.* Livingstone, the sixth most commonly reported serovar, was isolated from fewer holdings (5.5%) than *S.* Infantis, *S.* Rissen and *S.* London, but occurred in more participating countries (11).

The number of reported serovars ranged between one and 27 among the MSs reporting positive breeding holdings.

Table 4 Frequency distribution of isolated *Salmonella* serovars in breeding holdings, ranked by positive holdings, *Salmonella* EU baseline survey, 2008[(a)]

***Salmonella* serovars**	**Isolates**		**Holdings with serovars**		**Countries with serovars**
	N	**%[(b)]**	**N**	**%[(c)]**	**N**
S. Derby	312	23.9%	134	29.6%	18
S. Typhimurium	233	17.9%	115	25.4%	17
S. Infantis	65	5.0%	35	7.7%	7
S. Rissen	59	4.5%	33	7.3%	5
S. London	83	6.4%	29	6.4%	8
S. Anatum	49	3.8%	25	5.5%	5
S. Livingstone	71	5.4%	25	5.5%	11
S. Kedougou	26	2.0%	15	3.3%	4
S. Muenchen	30	2.3%	14	3.1%	6
S. Bredeney	27	2.1%	13	2.9%	6
S. Goldcoast	29	2.2%	13	2.9%	3
S. Agona	20	1.5%	9	2.0%	7
S. Bovismorbificans	25	1.9%	9	2.0%	5
S. Brandenburg	11	0.8%	8	1.8%	4
S. Enteritidis	15	1.2%	8	1.8%	4
S. Panama	16	1.2%	8	1.8%	4
S. Reading	25	1.9%	8	1.8%	2
S. Wien	11	0.8%	8	1.8%	1
S. Meleagridis	17	1.3%	7	1.5%	1
S. 4,5,12:i:-	13	1.0%	6	1.3%	4
S. 4,12:i:-	4	0.3%	4	0.9%	3
S. 4,5,12:d:-	17	1.3%	4	0.9%	1
S. 9,12:l,v:-	7	0.5%	4	0.9%	2
S. Give	8	0.6%	4	0.9%	3
S. Kapemba	7	0.5%	4	0.9%	1
S. Ohio	7	0.5%	4	0.9%	4
S. Amsterdam	14	1.1%	3	0.7%	2
S. Brikama	9	0.7%	3	0.7%	1
S. Mbandaka	5	0.4%	3	0.7%	3
S. Virchow	4	0.3%	3	0.7%	3

Table 4 (contd.): Frequency distribution of isolated *Salmonella* serovars in breeding holdings, ranked by positive holdings, *Salmonella* EU baseline survey, 2008[(a)]

***Salmonella* serovars**	**Isolates**		**Holdings with serovars**		**Countries with serovars**
	N	**%[(b)]**	**N**	**%[(c)]**	**N**
S. Worthington	3	0.2%	3	0.7%	3
S. Altona	3	0.2%	2	0.4%	2
S. Hadar	4	0.3%	2	0.4%	2
S. Manhattan	5	0.4%	2	0.4%	1
S. Senftenberg	2	0.2%	2	0.4%	2
S. 1,3,19:-:-	1	0.1%	1	0.2%	1
S. 6,7:-:1,5	2	0.2%	1	0.2%	1
S. Braenderup	2	0.2%	1	0.2%	1
S. Cerro	1	0.1%	1	0.2%	1
S. Coeln	1	0.1%	1	0.2%	1
S. Concord	1	0.1%	1	0.2%	1
S. Cubana	1	0.1%	1	0.2%	1
S. Falkensee	2	0.2%	1	0.2%	1
S. Heidelberg	2	0.2%	1	0.2%	1
S. IIIb 42:l,v:z	1	0.1%	1	0.2%	1
S. Lindenburg	1	0.1%	1	0.2%	1
S. Mishmarhaemek	2	0.2%	1	0.2%	1
S. Newport	1	0.1%	1	0.2%	1
S. Orion	5	0.4%	1	0.2%	1
S. Rubislaw	1	0.1%	1	0.2%	1
S. Saintpaul	2	0.2%	1	0.2%	1
S. Tennessee	1	0.1%	1	0.2%	1
S. Thompson	2	0.2%	1	0.2%	1
S. Uganda	2	0.2%	1	0.2%	1
Salmonella untypeable	36	2.8%	21	4.6%	6
Total	1,303		452		

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

(b): Proportion (%) of each specific *Salmonella* serovar out of the total isolates.

(c): Proportion (%) of holdings positive for each specific *Salmonella* serovar out of the total *Salmonella*-positive holdings.

4.5.2. Frequency distribution of *Salmonella* serovars in production holdings

In total, there were 2,699 *Salmonella*-positive isolates from 950 *Salmonella*-positive production holdings. Two different *Salmonella* serovars were isolated from 196 *Salmonella*-positive production holdings. The frequency distribution of isolated *Salmonella* serovars in the EU and the one non-MS, ranked by the number of positive holdings, is listed in Table 5. Eighty-eight different serovars were isolated from the faecal samples of production holdings across the EU. MS-specific overviews of the frequency distribution of serovars are shown in Appendix I (Figure 31, Table 15).

S. Derby and *S.* Typhimurium were highly predominant and widespread across MSs. *S.* Derby was the most frequently reported serovar in the EU and the two non-MSs, and was isolated in 28.5% of the *Salmonella*-positive production holdings. *S.* Derby was also the serovar most commonly isolated in terms of number of reporting countries: it was reported by 19 of the 21 MSs reporting *Salmonella*-positive production holdings, and in Switzerland. The next most commonly reported serovar in Europe was *S.* Typhimurium, which was isolated from 20.1% of the *Salmonella*-positive production holdings and reported by 15 MSs and by Switzerland. *S.* London and *S.* Infantis were, respectively, the third and fourth most frequently isolated serovars in Europe and represented 9.5% and 6.1%, respectively, of the *Salmonella*-positive holdings. Specifically, *S.* London was isolated in 15 MSs, notably in the United Kingdom, where it was the most frequently isolated serovar (27.4% of the *Salmonella*-positive production holdings), and in the Netherlands where it was the second most frequently isolated serovar (16.1% of the *Salmonella*-positive production holdings). *S.* Infantis was reported by 13 MSs, notably in Slovenia and France, where it was the second most frequently reported serovar (22.2% and 13.9% of the *Salmonella*-positive production holdings, respectively). *S.* Rissen was the fifth most commonly reported serovar. In contrast with the first four most frequent serovars, *S.* Rissen appeared to occur only in a few (six) countries, notably in Spain, where it represented the most common serovar (29.7% of the *Salmonella*-positive production holdings) and in Portugal, where it was the second most common (22.4%). Some serovars, for example *S.* Livingstone, *S.* Anatum, *S.* Bredeney and *S.* Goldcoast, were isolated from fewer holdings than the aforementioned serovars but occurred in more participating countries than *S.* Rissen.

The number of reported serovars ranged between one and 30 among MSs reporting isolates.

Table 5 Frequency distribution of isolated *Salmonella* serovars in production holdings, ranked by positive holdings, *Salmonella* EU baseline survey, 2008[(a)]

***Salmonella* serovars**	**Isolates**		**Holdings with serovars**		**Countries with serovars**
	N	**%[(b)]**	**N**	**%[(c)]**	**N**
S. Derby	641	23.7%	271	28.5%	20
S. Typhimurium	369	13.7%	191	20.1%	16
S. London	229	8.5%	90	9.5%	15
S. Infantis	132	4.9%	58	6.1%	13
S. Rissen	82	3.0%	56	5.9%	6
S. Livingstone	89	3.3%	50	5.3%	13
S. Anatum	117	4.3%	43	4.5%	10
S. Bredeney	76	2.8%	40	4.2%	13
S. Goldcoast	108	4.0%	39	4.1%	10
S. Bovismorbificans	56	2.1%	31	3.3%	9
S. Brandenburg	75	2.8%	27	2.8%	9
S. Agona	59	2.2%	24	2.5%	7
S. Enteritidis	45	1.7%	21	2.2%	10
S. Give	29	1.1%	18	1.9%	8
S. Reading	38	1.4%	18	1.9%	2
S. Panama	39	1.4%	16	1.7%	6
S. 4,5,12:i:-	25	0.9%	15	1.6%	7
S. Kedougou	26	1.0%	11	1.2%	3
S. Meleagridis	29	1.1%	11	1.2%	3
S. Mbandaka	14	0.5%	9	0.9%	8
S. Muenchen	20	0.7%	9	0.9%	2
S. 4,12:i:-	10	0.4%	6	0.6%	5
S. Stanley	9	0.3%	6	0.6%	3
S. 1,3,19:-:-	5	0.2%	5	0.5%	1
S. Kapemba	8	0.3%	5	0.5%	1
S. Montevideo	8	0.3%	5	0.5%	4
S. Newport	10	0.4%	5	0.5%	4
S. Wien	13	0.5%	5	0.5%	3
S. 4,12:d:-	7	0.3%	4	0.4%	4
S. 9,12:l,v:-	11	0.4%	4	0.4%	2
S. Kentucky	9	0.3%	4	0.4%	2
S. Manhattan	15	0.6%	4	0.4%	3
S. Muenster	5	0.2%	4	0.4%	3
S. Ohio	11	0.4%	4	0.4%	4
S. Virchow	8	0.3%	4	0.4%	3
S. Altona	6	0.2%	3	0.3%	2
S. Kimuenza	15	0.6%	3	0.3%	2
S. Litchfield	6	0.2%	3	0.3%	2
S. Senftenberg	5	0.2%	3	0.3%	3

Table 5 (contd.): Frequency distribution of isolated *Salmonella* serovars in production holdings, ranked by positive holdings, *Salmonella* EU baseline survey, 2008[a]

Salmonella serovars	Isolates		Holdings with serovars		Countries with serovars
	N	%[b]	N	%[c]	N
S. Tennessee	4	0.1%	3	0.3%	3
S. Worthington	4	0.1%	3	0.3%	3
S. 3,10:l,v:-	5	0.2%	2	0.2%	1
S. 4,5,12:d:-	6	0.2%	2	0.2%	1
S. 6,7:-:-	6	0.2%	2	0.2%	1
S. Cerro	9	0.3%	2	0.2%	2
S. Coeln	6	0.2%	2	0.2%	1
S. Dublin	2	0.1%	2	0.2%	2
S. Gloucester	3	0.1%	2	0.2%	1
S. Heidelberg	5	0.2%	2	0.2%	1
S. Indiana	4	0.1%	2	0.2%	1
S. Lille	2	0.1%	2	0.2%	2
S. Llandoff	2	0.1%	2	0.2%	1
S. 3,10:-:-	2	0.1%	1	0.1%	1
S. 4,12:b:-	2	0.1%	1	0.1%	1
S. 4,12:l,v:-	3	0.1%	1	0.1%	1
S. 4,5,12:-:-	1	0.0%	1	0.1%	1
S. 41:r:-	3	0.1%	1	0.1%	1
S. 6,7:r:-	1	0.0%	1	0.1%	1
S. 6,8:-:-	1	0.0%	1	0.1%	1
S. Abony	1	0.0%	1	0.1%	1
S. Braenderup	3	0.1%	1	0.1%	1
S. Brikama	2	0.1%	1	0.1%	1
S. Cannstatt	2	0.1%	1	0.1%	1
S. Carno	8	0.3%	1	0.1%	1
S. Choleraesuis	3	0.1%	1	0.1%	1
S. Dresden	1	0.0%	1	0.1%	1
S. Eko	1	0.0%	1	0.1%	1
S. Gaminara	2	0.1%	1	0.1%	1
S. Goettingen	2	0.1%	1	0.1%	1
S. Hadar	1	0.0%	1	0.1%	1
S. II 13,23:g,t:-	2	0.1%	1	0.1%	1
S. Idikan	1	0.0%	1	0.1%	1
S. Javiana	1	0.0%	1	0.1%	1
S. Liverpool	1	0.0%	1	0.1%	1
S. Loanda	1	0.0%	1	0.1%	1
S. London var. 15	1	0.0%	1	0.1%	1
S. Miami	1	0.0%	1	0.1%	1
S. Mishmarhaemek	4	0.1%	1	0.1%	1

Table 5 (contd.): Frequency distribution of isolated *Salmonella* serovars in production holdings, ranked by positive holdings, *Salmonella* EU baseline survey, 2008[a]

***Salmonella* serovars**	**Isolates**		**Holdings with serovars**		**Countries with serovars**
	N	**%[b]**	**N**	**%[c]**	**N**
S. Nottingham	1	0.0%	1	0.1%	1
S. Pakistan	1	0.0%	1	0.1%	1
S. Putten	1	0.0%	1	0.1%	1
S. Saintpaul	1	0.0%	1	0.1%	1
S. Stanleyville	2	0.1%	1	0.1%	1
S. Stourbridge	1	0.0%	1	0.1%	1
S. Thompson	1	0.0%	1	0.1%	1
S. Tilburg	2	0.1%	1	0.1%	1
S. Virginia	1	0.0%	1	0.1%	1
S. Westhampton	1	0.0%	1	0.1%	1
Salmonella untypeable	119	4.4%	64	6.7%	11
Total	2,699		950		

[a] Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

[b]: Proportion (%) of each specific *Salmonella* serovar out of the total isolates.

[c]: Proportion (%) of holdings positive for each specific *Salmonella* serovar out of the total *Salmonella*-positive holdings.

4.6. Overview of the quality of the *Salmonella* testing

In the technical specifications of the baseline survey, it was indicated that all strains isolated and confirmed as *Salmonella* should be serotyped according to the Kaufmann-White scheme. For quality assurance of serotyping, a maximum of 16 typeable strains and 16 non-typeable isolates of the one-year survey should be sent to the Community Reference Laboratory for *Salmonella* (CRL-*Salmonella*). If fewer strains were isolated, all should be sent.

The CRL-*Salmonella* reported on the quality of the serotyping of typeable strains and non-typeable isolates of *Salmonella* from the baseline survey in breeding pigs.

Twenty-two National Reference Laboratories for *Salmonella* (NRLs-*Salmonella*) (of the 24 participating MSs) sent in typeable strains to the CRL; the NRL Finland indicated that it did not isolate any *Salmonella* during the baseline survey and the NRL Bulgaria gave no clarification why they did not send isolates. A total of 278 typeable strains were received by the CRL-*Salmonella*. Seventeen strains (6.1%) were serotyped differently by CRLs compared to NRLs. This may be due to differences in materials or methods used by the NRLs.

Fifteen NRLs-*Salmonella* sent in non-typeable isolates to the CRL. A total of 79 non-typeable isolates were received by the CRL-*Salmonella*. Of these strains, CRL-*Salmonella* was able to give a further 16 serovar strain names. The unavailability of a complete set of specific antisera in certain MSs may explain the difficulty experienced by these NRLs in identifying a number of strains at the level of the serovar.

5. Discussion

This baseline survey was conducted by 24 MSs and two non-MSs with the aim of providing a baseline estimate for the prevalence of *Salmonella*-positive holdings with breeding pigs in the EU. The results of these 24 MSs were extrapolated to cover the whole EU. Overall, few sampled holdings were excluded from the analyses and in most MSs large proportions of existing breeding and production holdings were included in the survey.

Salmonella infection in pigs is often sub-clinical and shedding may occur intermittently for long periods, leading to the persistence of infection in some herds. Although breeding pigs do enter the food chain at the end of their productive lives, such animals are probably a minor contributor to the risk of *Salmonella* infections in humans. More importantly, persistent infection in breeding pigs may play an important role in the maintenance and transmission of *Salmonella* infection, either to the slaughter pig generation (production herds), or act as a source of infection to the breeding pigs whose progeny will become the slaughter generation (nucleus and multiplier herds). Where the progeny is destined for slaughter, there is a direct risk of transmission of *Salmonella* through the food chain with resulting implications for food safety. There is convincing evidence that some human cases of salmonellosis are attributable to infection derived from *Salmonella* infected pigs or products of pig origin but the population attributable fraction for the EU has not been estimated (EFSA, 2006b).

5.1. Prevalence of *Salmonella* in holdings with breeding pigs

Salmonella was commonly detected in holdings with breeding pigs and the EU prevalence of *Salmonella*-positive holdings was high, at 31.8%. All but one of the 24 participating MSs detected *Salmonella* in at least one holding. This means that approximately one third of holdings with breeding pigs were estimated to be infected with *Salmonella* in the EU and they represent a source of infection for other pigs – either breeding herds lower down the pyramid or directly to slaughter pigs.

The variation in *Salmonella* prevalence among MSs was large and, overall, the findings of the present survey demonstrate the heterogeneity of the situation between the EU MSs. Explanatory factors for this variability should be investigated further as this may be of value to inform decisions on future control measures.

For pragmatic reasons only, the sampling scheme within the holdings was set to detect holdings with at least one tenth (10%) of the breeding pigs infected with *Salmonella*. Therefore, the survey design potentially misclassified some holdings as negative when actually they were likely to have breeding pigs infected with *Salmonella*. The true prevalence of *Salmonella*–positive holdings may, therefore, be higher than the one presented here. However, the study design does take into account the substantial clustering of infection on pig holdings, which typically comprise numerous separate groups of pigs with varying degrees of spatial separation. The sensitivity of the sampling methods and potential impact on prevalence estimates will be investigated in the Part B report.

During the analysis of the survey results it was decided that for the EU prevalence estimate, observations from holdings with less than 50 breeding pigs should be excluded in order to present a prevalence representative for a clearly defined population i.e. holdings with 50 or more breeding pigs. Indeed, an EU prevalence estimate based on observations from all holdings would not be representative for those MSs where only few or no holdings with less than 50 breeding pigs were sampled. The removal of these observations for EU prevalence did not have a large impact on the EU level estimate, as this was based heavily on data from holdings with at least 50 breeding pigs. However, smaller holdings were retained in the individual MS prevalence estimates because these holdings were eligible to be surveyed whenever the selected holdings with at least 50 breeding pigs did not contain together 80% of the national herd of breeding pigs. However these varying sampling populations may render the comparison of prevalence across MSs rather challenging.

There was a distinct spatial pattern of higher *Salmonella* prevalence in the Western part of Europe, both in breeding and in production holdings. Analyses of factors that might explain this observation will be explored in the Part B report.

5.1.1. Breeding holdings

Breeding holdings are of special importance for *Salmonella* infections in pigs. They are at a crucial position at the top of the production pyramid and thus have a unique potential role in the dissemination of *Salmonella* infection throughout the whole production chain. It is therefore important that these holdings be given special consideration. The survey results show that, of the 24 MSs participating in the survey, 20 reported *Salmonella* infection in breeding holdings giving an EU level prevalence of 28.7% with 95% CI of 26.3% to 31.0%. This means that almost one third of breeding holdings in the EU were estimated to be infected with *Salmonella*. Five countries (Estonia, Finland, Lithuania, Slovenia and Norway) reported no *Salmonella* in breeding holdings. Switzerland also reported *Salmonella*-positive breeding holdings.

There was considerable variation in the prevalence of *Salmonella* between different MSs. A total of 11 MSs had prevalences above the EU prevalence, and Spain, the Netherlands, the United Kingdom, Italy, France, Ireland, and Cyprus all had a prevalence of 50% or more, whereas Estonia, Finland, Lithuania, Slovenia and Norway reported no *Salmonella*-positive breeding holdings in the survey.

5.1.2. Production holdings

The EU prevalence of *Salmonella*-positive holdings was 33.3% (95% CI 30.9% - 35.7%) meaning that one third of production holdings in the EU were estimated to be infected with *Salmonella*. Four countries (Bulgaria, Finland, Sweden and Norway) reported no *Salmonella* in production holdings. Switzerland also reported *Salmonella* in production holdings.

Once again there was a large variation between MSs in prevalence. A total of nine MSs had prevalences above the EU prevalence and Spain and the Netherlands had a prevalence of 50% or more.

The EU level prevalence of *Salmonella*-positive holdings seemed not to differ between breeding and production holdings. Still, certain MSs had a higher prevalence in breeding holdings than in production holdings, while others found *Salmonella* more often in production holdings compared to breeding holdings.

5.1.3. Prevelence of *Salmonella* serovars

At EU level the prevalence of *S.* Derby and *S.* Typhimurium seemed not to differ between breeding and production holdings. On the contrary, the EU prevalence of production holdings positive for serovars other than *S.* Typhimurium and/or Derby was slightly higher than that of breeding holdings. Also at the MS-level there were more MSs having a higher prevalence of production holdings positive for serovars other than *S.* Typhimurium and/or Derby than MS having a higher prevalence of these serovars in breeding holdings. Analyses of factors that might explain these observations will be explored in the Part B report.

5.2. Frequency distribution of *Salmonella* serovars

Overall there were 99 different *Salmonella* serovars identified in the survey. The number of different *Salmonella* serovars isolated was higher in production holdings than in breeding holdings, 88 and 54, respectively. This higher serovar diversity in production holdings may be due to the fact that more samples were collected in production holdings, but could also be attributed to the fact that breeding holdings typically breed their own replacement pigs whereas production holdings may buy in

replacement breeding stocks from a wide range of breeding holdings, each of which may be infected with different *Salmonella* serovars.

S. Derby was the most frequently isolated serovar at EU level in both breeding and production holdings (from 29.6% and 28.5% of positive holdings, respectively). It was found in breeding holdings in 17 MSs and in production holdings in 19 MSs. The second most commonly isolated serovar was *S.* Typhimurium (from 25.4% of positive breeding holdings in 16 MSs and from 20.1% of positive production holdings in 15 MSs). These two serovars, which were clearly predominating in holdings with breeding pigs, have been closely associated with pig breeding and production for many years (EC, 2002, 2003a, 2004, 2005a; EFSA, 2005, 2006a, 2007a, 2008, 2009a) and were also identified as frequently isolated serovars in the EU wide slaughter pig survey (EFSA, 2008). The next most frequently reported serovars in both breeding and production holdings were *S.* London, *S.* Infantis and *S.* Rissen, each accounting for approximately 7% of the positive holdings.

The serovar diversity varied also between MSs. Several serovars, e.g. *S.* London, which is uncommon in food animals other than pigs (EFSA, 2009a), as well as *S.* Livingstone and *S.* Infantis, were found in a variety of MSs, particularly those in Western Europe, with a relatively high occurrence. This indicates a likely common source for infection, such as trade in breeding pigs. Some serovars, such as *S.* Kedougou and *S.* Meleagridis, had a more restricted geographical distribution which may indicate MS-specific sources of infection, such as contaminated feed or infected breeding herds with only national distribution of pigs. *S.* Choleraesuis, a serovar that is particularly pathogenic to both pigs and humans, was found only in one holding in this survey.

Isolates belonging to monophasic group B *Salmonella, S.* 4,[5],12:i:-, were reported by several MSs in breeding and production holdings. This type of *Salmonella* is most likely to be a variant of *S.* Typhimurium. Such isolates have been associated predominantly to *S.* Typhimurium DT193 that shows resistance to some commonly used antibiotics. These strains have been increasing notably in the EU since 2006 and have also been found in the USA and Canada (PHAC, 2006; CDC, 2007a, 2007b; Switt et al 2009). Monophasic *S.* Typhimurium strains have been reported from pigs, cattle, poultry and humans (de la Torre et al 2003; Sorensen et al., 2002; Zamperini et al 2007). There have been major food-borne outbreaks involving this strain in humans in MSs and many non-European countries (Agasan et al 2002; Tavechio et al 2004; Amavisit et al 2005; Mossong et al 2007). The strain was the fifth most commonly reported strain in lymph nodes in the EUwide baseline survey of slaughter pigs that was carried out in 2006- 2007 (EFSA, 2008). The emergence of these new *S.* Typhimurium strains in pig populations and their subsequent spread to other animal species and humans is of public health significance. It is therefore recommended to further study the epidemiology of monophasic *S.* Typhimurium.

The *Salmonella* reduction target for breeding flocks of *Gallus gallus* (EC, 2005b) designates five serovars as being of special public health significance; *S.* Enteritidis, *S.* Typhimurium, *S.* Infantis, *S.* Virchow and *S.* Hadar. Apart from *S.* Typhimurium, the occurrence of the other four serovars was low in this survey in breeding pigs. *S.* Infantis was found in 7.7% of *Salmonella*–positive breeding holdings and in 6.1% of *Salmonella*–positive production holdings. *S.* Enteritidis was isolated in both breeding and production holdings from several MSs and while this serovar is typically associated with poultry production, it does occur sporadically in pigs (EFSA, 2009a).

Correlations between the prevalence of *Salmonella* and the occurrence of certain serovars in breeding holdings, in production holdings, in slaughter pigs, in other animal species and in pig meat as well as in human salmonellosis cases will be studied further in the Part B report.

5.3. Relevance of the findings to human health

Serovars often reported from salmonellosis cases in humans were detected in both breeding and production holdings in this survey. Of these serovars, *S.* Typhimurium is commonly reported in human

salmonellosis cases in the EU, whereas the other serovars generally constitute a minor proportion of human infections (EFSA, 2009a).

Although the consumption of pig meat constitutes a source of human *Salmonella* infections (EFSA, 2006b), there is no data available to suggest that the consumption of meat from culled sows and boars is a significant direct source of food-borne salmonellosis. Consequently the main purpose of controlling *Salmonella* in breeding pigs is to prevent dissemination of *Salmonella* during later stages of production i.e. to rearing and fattening pigs. This dissemination may lead to *Salmonella*-contamination of pig meat and consequently to human disease. Interventions to reduce the prevalence of infection in breeding pigs may therefore reduce the number of human salmonellosis cases. Safe handling of raw meat and thorough cooking are also important measures to minimise human health risks from *Salmonella*-contaminated pig meat.

Interventions aimed at the breeding sector have been successful in reducing the prevalence of *Salmonella* in poultry (EFSA, 2009a, 2009b), but so far few countries have attempted to focus *Salmonella* control in holdings of breeding pigs. The occurrence of *Salmonella* transmission from breeding pigs to slaughter pigs often leads to the establishment of cycles of persistent infection during the fattening stages, and the current move to later weaning ages of piglets is likely to increase the chance of transmission of *Salmonella* from an infected dam to her offspring as colostral immunity wanes (Porter et al., 1970; Soerensen et al., 2004).

In conclusion, further studies on the public health importance of consumption of meat from culled breeding pigs and in surveillance and control methods for *Salmonella* in breeding pigs would be welcome.

The findings of this survey will be used to inform the setting of targets for the reduction of *Salmonella* in breeding herds of pigs in line with Regulation (EC) No 2160/2003 (EC, 2003b) on the control of *Salmonella* and other specified zoonotic agents.

CONCLUSIONS

- This baseline survey was the first survey on *Salmonella* in holdings with breeding pigs in the EU. It provides comparable estimates of the prevalence of *Salmonella*-positive holdings with breeding pigs for the EU MSs and provides a description of the occurrence of *Salmonella* across the EU. These baseline prevalence figures may be used in the future to follow trends and to evaluate the impact of control programmes.
- The survey demonstrated that *Salmonella* is very common in holdings with breeding pigs, either breeding or production holdings, and widely distributed in the EU. All but one of the 24 participating MSs detected *Salmonella* in at least one of their holdings.
- Twenty of the 24 MSs isolated *Salmonella* in breeding holdings. At EU level approximately one in three breeding holdings (28.7%) was estimated to be positive for *Salmonella*. The prevalence of *Salmonella*-positive breeding holdings varied widely among the MSs from 0% to 64.0%. The estimated EU prevalence of breeding holdings specifically positive for *S.* Typhimurium and *S.* Derby was 7.8% and 8.9%, respectively.
- Twenty-one of the 24 MSs isolated *Salmonella* in production holdings. At EU level one-third of the production holdings (33.3%) were estimated to be positive for *Salmonella*. The prevalence of *Salmonella*-positive production holdings also varied widely among the MSs from 0% to 55.7%. The estimated EU prevalence of production holdings specifically positive for *S.* Typhimurium and *S.* Derby was 6.6% and 9.0%, respectively.
- The number of different *Salmonella* serovars isolated in breeding holdings and production holdings across the European Union was 54 and 88, respectively. *S.* Derby was the most frequently isolated serovar in both breeding and production holdings, detected in 29.6% and 28.5% of the *Salmonella*-positive holdings, respectively. The second most commonly isolated serovar was *S.* Typhimurium accounting for 25.4% and 20.1% of *Salmonella*-positive breeding holdings and production holdings, respectively. The next most frequently reported serovars were *S.* London, *S.* Infantis and *S.* Rissen both in breeding and production holdings and each accounted for approximately 7% of the positive holdings, in each type of holding. Of these serovars, *S.* Typhimurium is also commonly reported in human salmonellosis cases in the EU, whereas the other serovars generally constitute a minor proportion of human infections.
- *Salmonella* isolates with the incomplete antigenic formula 4,[5],12:i:- were found in several MSs. These are likely to be related to the recent emergence of monophasic *S.* Typhimurium, which has been found predominantly in pigs and humans.
- The main public health importance of *Salmonella* in breeding pigs is the potential dissemination of the bacteria to rearing and fattening pigs. This may lead to *Salmonella* contamination of pig meat and consequently to human infection.
- The results of this survey will support the risk managers in setting targets for the reduction of the prevalence of *Salmonella* infection in holdings with breeding pigs in the EU.

RECOMMENDATIONS

- Detailed research on the epidemiology and, in particular, effective surveillance methods (i.e. monitoring and control) of *Salmonella* in primary breeding pigs are sparse and such studies would therefore be welcome.
- Since knowledge of the public health impact of the consumption of meat and offal from culled sows is lacking, studies to elucidate this issue would be desirable.
- Molecular typing studies on the stored isolates of monophasic *Salmonella* strains such as *S.* 4,[5],12:i:- from this survey, as well as epidemiological studies, are required to confirm that these strains are part of the increasing trend of monophasic *S.* Typhimurium strains and to explore factors that are driving this emergence.

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APPENDICES

LIST OF APPENDICES

A GENERAL FEATURES OF THE EU AND TWO NON-MSS, POPULATION OF HOLDINGS WITH BREEDING PIGS

Table 6 Overview of the population of holdings with breeding pigs[a], *Salmonella* EU baseline survey, 2008[b]

Country	Breeding holdings			Production holdings			Total holdings with breeding pigs		
	<50 breeding pigs	≥50 breeding pigs	Total	<50 breeding pigs	≥50 breeding pigs	Total	<50 breeding pigs	≥50 breeding pigs	Total
Austria	128	153	281	11 191	2 703	13 894	11 319	2 856	14 175
Belgium	NA[c]	286	286	1	3 731	3 732	1	4 017	4 018
Bulgaria	18	43	61	1	384	385	19	427	446
Cyprus	0	4	4	9	87	96	9	91	100
Czech Republic	26	195	221	988	1 973	2 961	1 014	2 168	3 182
Denmark	12	186	198	852	2 407	3 259	864	2 593	3 457
Estonia	1	7	8	3	28	31	4	35	39
Finland	40	99	139	431	502	933	471	601	1 072
France	12	452	464	2 844	5 746	8 590	2 856	6 198	9 054
Germany	NA	380	380	16 416	12 110	28 526	16 416	12 490	28 906
Hungary	1	39	40	NA	485	485	1	524	525
Ireland	2	39	41	15	290	305	17	329	346
Italy	2 610	186	2 796	5 026	1 018	6 044	7 636	1 204	8 840
Latvia	0	7	7	0	39	39	0	46	46
Lithuania	0	11	11	0	85	85	0	96	96
Luxembourg	0	3	3	14	27	41	14	30	44
Netherlands	29	464	493	185	2 775	2 960	214	3 239	3 453
Poland[d]	4 176	1 399	5 575	159 101	3 926	163 027	163 277	5 325	168 602
Portugal	NA	39	39	2 804	836	3 640	2 804	875	3 679
Slovakia	41	93	134	1 088	207	1 295	1 129	300	1 429
Slovenia	12	21	33	5 852	49	5 901	5 864	70	5 934
Spain	39	415	454	21 865	12 449	34 314	21 904	12 864	34 768
Sweden	3	76	79	596	761	1 357	599	837	1 436
United Kingdom	NA	130	130	NA	1 539	1 539	NA	1 669	1 669
EU (24 MSs)	7 150	4 727	11 877	229 282	54 157	283 439	236 432	58 884	295 316
Norway	11	124	135	903	631	1 534	914	755	1 669
Switzerland	27	87	114	1 149	821	1 970	1 176	908	2 084

(a): Where MSs were not able to provide EFSA with any detailed estimates on the number on breeding and production holdings separately, the missing population estimates were extrapolated from the sample level dataset of the *Salmonella* EU baseline survey, 2008.
(b): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.
(c): NA = data not reported.
(d): 2009 data.

Figure 10 Proportion (%) of breeding holdings with ≥50 breeding pigs, *Salmonella* EU baseline survey, 2008[(a)]

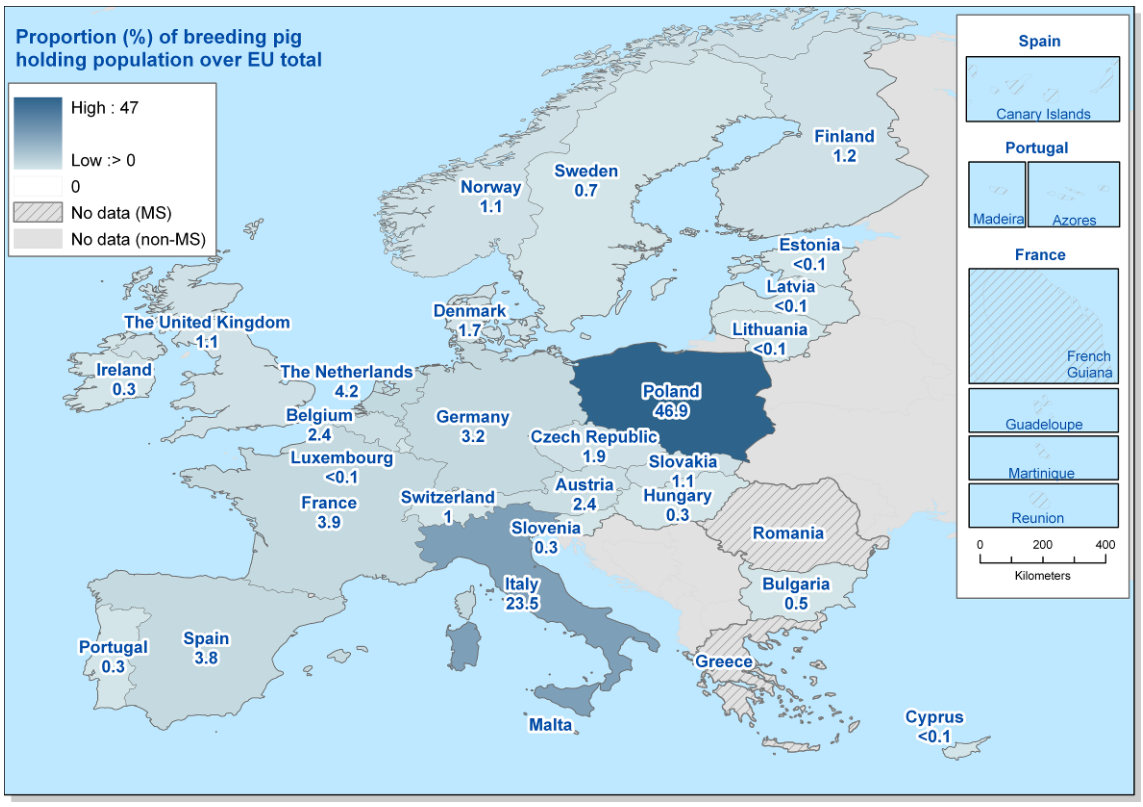

Figure 11 Proportion (%) of breeding holdings population, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

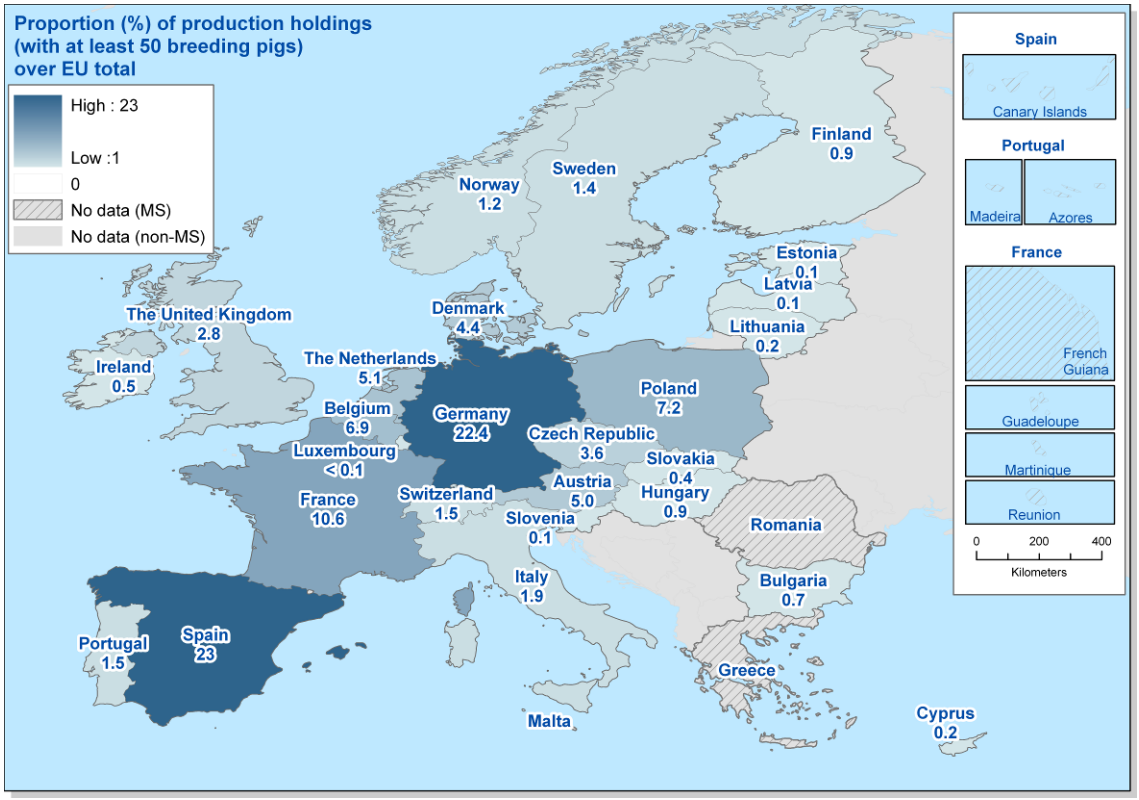

Figure 12 Proportion (%) of production holdings with ≥50 breeding pigs, *Salmonella* EU baseline survey, 2008[(a)]

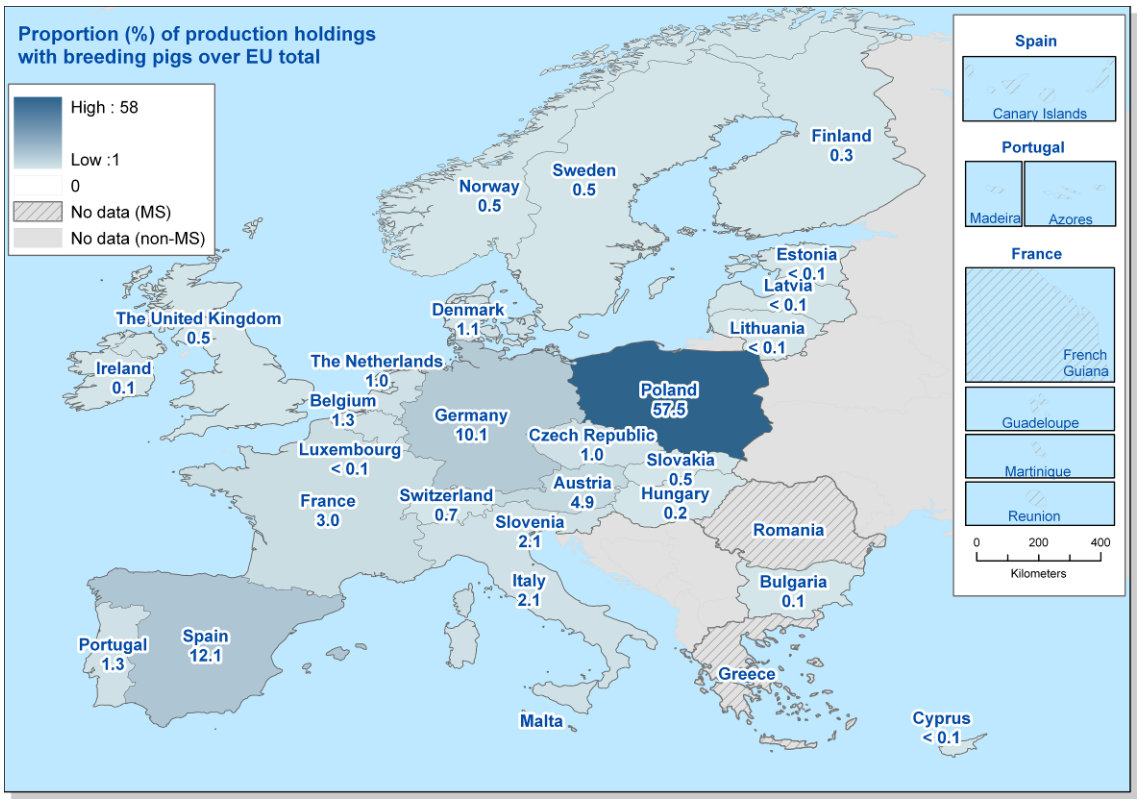

Figure 13 Proportion (%) of production holdings with breeding pigs, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

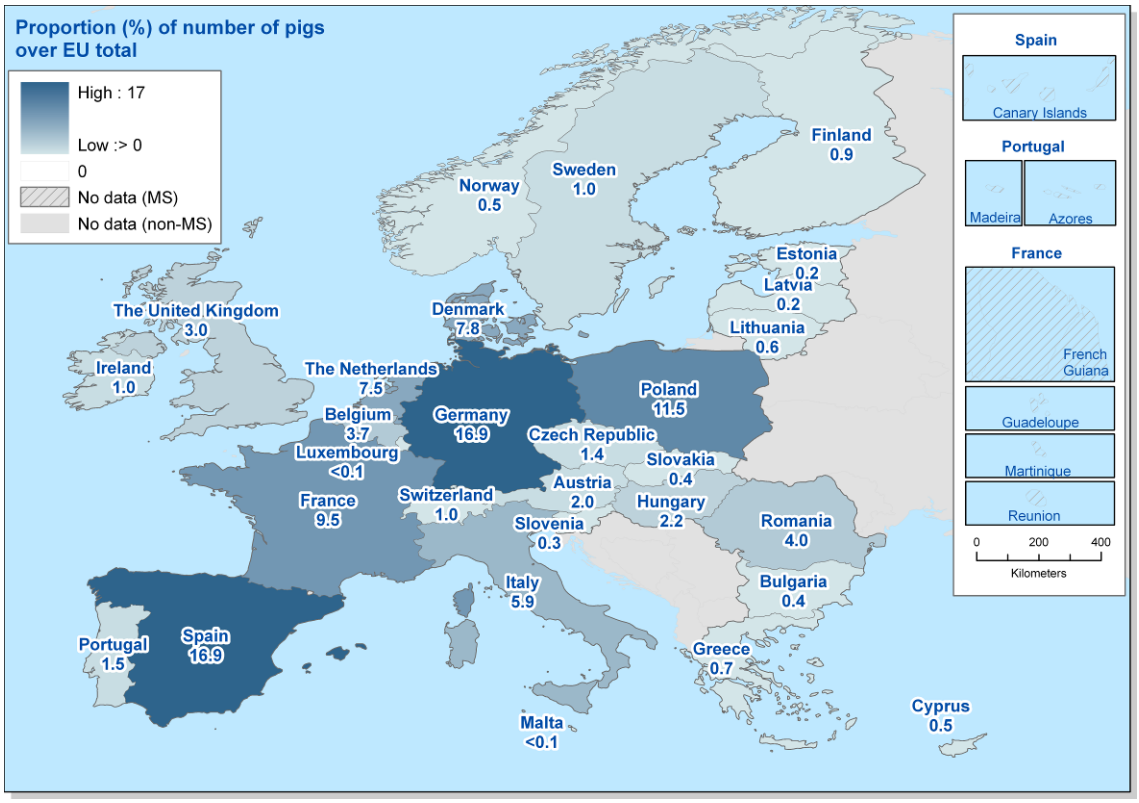

Figure 14 Proportion (%) of pig population[(a)], *Salmonella* EU baseline survey, 2008[(b)]

(a): Total pig population including breeding and fattening pigs.
(b): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

B LIST OF CRITERIA USED TO IDENTIFY NON-VALID AND NON-PLAUSIBLE INFORMATION IN THE *SALMONELLA* DATABASE, *SALMONELLA* BASELINE SURVEY IN THE EU, 2008

The variables are uniquely identified using the 'item integer' mentioned in the ad hoc Data Dictionary.

Criterion	Rationale for the criterion
C 1	003 Date of sampling: >15 January 2009 This criterion excludes all records containing a date of sampling after 15 January 2009
C 2[(a)]	012 Number of pigs in pen: <10 This criterion excludes all records of holdings where less than 10 breeding pigs were present in each sampled "pen"
C 3	Block 3 routine pooled samples: exactly 10 per holding This criterion excludes all records not containing 10 routine samples per holding
C 4	024 Weight of sample: <25 grams This criterion excludes all records with faecal material of a sample weighing less than 25 grams
C 5	026 Date of bacteriological detection testing: <15 December 2007 This criterion excludes all records containing a date of primary testing in the laboratory before 15 December 2007
C 6	026 Date of bacteriological detection testing: <value of 003 Date of sampling This criterion excludes all records containing a date of primary testing in the laboratory before the date of sampling
C 7	Difference date between: '003 Date of sampling' and '026 Date of bacteriological detection testing': >7 This criterion excludes all records containing a 'days to bacteriological start of test' over seven days
C 8	031 *Salmonella* serovar: IS NULL (EMPTY) and 027 Test result is 'positive' This criterion excludes all records containing positive test results with no information on the serovar
C 9	031 *Salmonella* serovar: IS NOT NULL (NOT EMPTY) and 027 Test result is 'negative' This criterion excludes all records containing negative test results with information on the serovar

(a): This exclusion criterion C2 was not strictly adhered to, see Materials and methods, section 3.2.

C STATISTICAL METHODOLOGY USED IN THE ANALYSIS OF THE BASELINE SURVEY ON THE PREVALENCE OF *SALMONELLA* IN HERDS WITH BREEDING PIGS IN THE EU, 2008

Prevalence in each participating country

The observed prevalence of *Salmonella*-positive holdings in each country was calculated as the fraction of *Salmonella*-positive holdings in this country, including a 95% confidence interval (CI) based on a finite population approach. The finite population approach is appropriate in the case when there are only a limited number of holdings (N) in a country, of which a considerable part (n) has been sampled. The approach assumes that the prevalence in the n holdings that were sampled is certain. Therefore, if a country has only five holdings, and they are all in the sample (census sampling), the prevalence in this country, according to the finite population approach, is known with complete certainty. One caveat, however, is that holdings were sampled only at a single moment in time, and that the persistence of *Salmonella* positivity in time is uncertain. It might well be that a holding tested positive in one part of the year might be negative in another (i.e. the approach is ignoring any false negatives). Without the knowledge of the magnitude of the within-holding correlation of positive findings, however, this cannot be taken into account. This is especially influential in the case of census sampling, where the finite population approach gives a CI that is equal to the point estimate. The true CI is likely to be larger, but cannot be calculated.

In order to estimate a CI based on a finite population, the total number of holdings in each country (N) must be known. In countries that sampled exclusively breeding pig/production holdings with at least 50 breeding pigs, the total number of breeding/production holdings with a least 50 breeding pigs was used. In countries where holdings with less than 50 breeding pigs were sampled, the total number of breeding pig/production holdings was used. This choice does not influence the point estimate, only the calculation of the CI. Exact 95% CIs were calculated based on the hypergeometric distribution.

Prevalence at EU level

EU level prevalence was estimated by weighting each MS prevalence with the fraction of its holdings out of the total number of holdings in the EU. As the survey aims to estimate the prevalence in holdings with at least 50 breeding pigs (covering at least 80% of the total breeding pig population), the EU prevalence p_{EU} was estimated based on the data from holdings with ≥50 breeding pigs, using the following formula:

$$p_{EU} = \sum_{MS} \frac{\#holdings_{MS}}{\sum_{MS} \#holdings_{MS}} p_{MS} \quad (1) \Leftrightarrow \quad p_{EU} = \frac{\sum_{MS} \left(1/f_{MS}\right).(\#\ positive\ holdings\ in\ sample_{MS})}{\sum_{MS} \#holdings} \quad (2)$$

Here p_{MS} is the prevalence of *Salmonella*-positive holdings in holdings with at least 50 breeding pigs in the MS and $\#holdings_{MS}$ is the total number of holdings with at least 50 breeding pigs in the MS. f_{MS} is the sampling fraction of holdings with at least 50 breeding pigs in the MS. These numbers were provided by MSs (Appendix A). Note that while holdings with <50 breeding pigs were not included in this estimate, they were included in the estimates for the individual MS. In these individual MSs these holdings are needed to make the survey cover at least 80% of the breeding pigs in the MS, while this is not the case at EU level.

Another approach would have been to use # $holdings_{MS}$ equal to the total number of holdings in the MS, and include all sampled holdings. However, in many MSs, this would mean extrapolating findings from holdings with at least 50 breeding pigs to a large number of smaller holdings, while no such holdings are in the sample. As smaller holdings might have a different chance of being positive for *Salmonella*, such an extrapolation cannot be justified. The EU prevalence was estimated using SAS 9.2, PROC SURVEYREG, including only holdings with at least 50 breeding pigs, both in the case of the sample of holdings, and for the total number of holdings in each MS.

D OVERVIEW OF THE NUMBER OF HOLDINGS WITH AT LEAST 50 BREEDING PIGS, *SALMONELLA* EU BASELINE SURVEY, 2008[(a)]

Member State	Breeding holdings ≥50 breeding pigs				Production holdings ≥50 breeding pigs			
	No of Sampled Holdings	Total No of Holdings	Sampling fraction	Weight	No of Sampled Holdings	Total No of Holdings	Sampling fraction	Weight
Austria	65	153	0.42	2.35	135	2,703	0.05	20.02
Belgium	16	286	0.06	17.88	208	3,731	0.06	17.94
Bulgaria	43	43	1.00	1.00	24	384	0.06	16.00
Cyprus	4	4	1.00	1.00	60	87	0.69	1.45
Czech Republic	106	195	0.54	1.84	160	1,973	0.08	12.33
Denmark	95	186	0.51	1.96	195	2,407	0.08	12.34
Estonia	6	7	0.86	1.17	28	28	1.00	1.00
Finland	50	99	0.51	1.98	149	502	0.30	3.37
France	156	452	0.35	2.90	185	5,746	0.03	31.06
Germany	46	380	0.12	8.26	155	12,110	0.01	78.13
Hungary	39	39	1.00	1.00	141	485	0.29	3.44
Ireland	38	39	0.97	1.03	148	290	0.51	1.96
Italy	43	186	0.23	4.33	169	1,018	0.17	6.02
Latvia	5	7	0.71	1.40	28	39	0.72	1.39
Lithuania	10	11	0.91	1.10	72	85	0.85	1.18
Luxembourg	3	3	1.00	1.00	27	27	1.00	1.00
Netherlands	109	464	0.23	4.26	212	2,775	0.08	13.09
Poland	121	1,399	0.09	11.56	157	3,926	0.04	25.01
Portugal	33	39	0.85	1.18	131	836	0.16	6.38
Slovakia	93	93	1.00	1.00	86	207	0.42	2.41
Slovenia	23	21	1.10[(b)]	0.91	47	49	0.96	1.04
Spain	150	415	0.36	2.77	209	12,449	0.02	59.56
Sweden	56	76	0.74	1.36	133	761	0.17	5.72
United Kingdom	67	130	0.52	1.94	191	1,539	0.12	8.06
Norway	82	124	0.66	1.51	74	631	0.12	8.53
Switzerland	71	87	0.82	1.23	154	821	0.19	5.33

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs: Norway and Switzerland, participated.

(b): As the number of breeding holdings in the sample was larger than the number of breeding holdings reported by the country, the sampling fraction was assumed to be 1.

E RESULTS OF THE DESCRIPTIVE ANALYSIS OF THE SAMPLE DATA OF THE *SALMONELLA* BASELINE SURVEY IN HOLDINGS WITH BREEDING PIGS

Table 7 Number and percentage of breeding holdings included in the survey by the month of sampling, *Salmonella* EU baseline survey, 2008[(a)]

Member State	Month of sampling																						Total
	Jan 08		Feb 08		Mar 08		Apr 08		May 08		Jun 08		Jul 08		Aug 08		Sep 08		Oct 08		Nov 08		Dec 08		
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
Austria	7	(8.9)	5	(6.3)	6	(7.6)	6	(7.6)	8	(10.1)	7	(8.9)	3	(3.8)	9	(11.4)	2	(2.5)	8	(10.1)	8	(10.1)	10	(12.7)	79
Belgium	0	(0.0)	0	(0.0)	1	(6.3)	1	(6.3)	1	(6.3)	1	(6.3)	1	(6.3)	2	(12.5)	1	(6.3)	3	(18.8)	3	(18.8)	2	(12.5)	16
Bulgaria	0	(0.0)	0	(0.0)	1	(2.1)	0	(0.0)	1	(2.1)	7	(14.9)	1	(2.1)	0	(0.0)	0	(0.0)	17	(36.2)	17	(36.2)	3	(6.4)	47
Cyprus	1	(25.0)	0	(0.0)	0	(0.0)	1	(25.0)	0	(0.0)	0	(0.0)	1	(25.0)	0	(0.0)	0	(0.0)	1	(25.0)	0	(0.0)	0	(0.0)	4
Czech Republic	0	(0.0)	5	(4.7)	19	(17.9)	16	(15.1)	16	(15.1)	11	(10.4)	9	(8.5)	7	(6.6)	6	(5.7)	9	(8.5)	8	(7.5)	0	(0.0)	106
Denmark	0	(0.0)	1	(1.1)	5	(5.3)	5	(5.3)	9	(9.5)	13	(13.7)	8	(8.4)	7	(7.4)	16	(16.8)	10	(10.5)	13	(13.7)	8	(8.4)	95
Estonia	1	(16.7)	0	(0.0)	0	(0.0)	2	(33.3)	1	(16.7)	1	(16.7)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	1	(16.7)	6
Finland	3	(6.0)	4	(8.0)	4	(8.0)	0	(0.0)	4	(8.0)	4	(8.0)	3	(6.0)	5	(10.0)	5	(10.0)	2	(4.0)	5	(10.0)	9	(18.0)	50
France	4	(2.5)	17	(10.8)	13	(8.3)	0	(0.0)	16	(10.2)	19	(12.1)	12	(7.6)	12	(7.6)	16	(10.2)	11	(7.0)	16	(10.2)	7	(4.5)	157
Germany	0	(0.0)	1	(2.2)	4	(8.7)	3	(6.5)	2	(4.3)	5	(10.9)	3	(6.5)	5	(10.9)	8	(17.4)	5	(10.9)	4	(8.7)	6	(13.0)	46
Hungary	0	(0.0)	0	(0.0)	1	(2.5)	6	(15.0)	8	(20.0)	3	(7.5)	4	(10.0)	2	(5.0)	2	(5.0)	5	(12.5)	2	(5.0)	7	(17.5)	40
Ireland	2	(5.0)	3	(7.5)	1	(2.5)	4	(10.0)	1	(2.5)	6	(15.0)	5	(12.5)	2	(5.0)	6	(15.0)	6	(15.0)	2	(5.0)	2	(5.0)	40
Italy	0	(0.0)	0	(0.0)	1	(2.3)	4	(9.3)	3	(7.0)	6	(14.0)	4	(9.3)	4	(9.3)	6	(14.0)	5	(11.6)	8	(18.6)	2	(4.7)	43
Latvia	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	1	(20.0)	1	(20.0)	1	(20.0)	2	(40.0)	0	(0.0)	0	(0.0)	0	(0.0)	5
Lithuania	0	(0.0)	0	(0.0)	4	(40.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	1	(10.0)	1	(10.0)	1	(10.0)	1	(10.0)	2	(20.0)	10
Luxembourg	0	(0.0)	0	(0.0)	0	(0.0)	1	(33.3)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	2	(66.7)	0	(0.0)	3
Netherlands	4	(3.7)	1	(0.9)	3	(2.8)	8	(7.3)	8	(7.3)	12	(11.0)	14	(12.8)	8	(7.3)	19	(17.4)	14	(12.8)	18	(16.5)	0	(0.0)	109
Poland	10	(6.9)	13	(9.0)	16	(11.1)	11	(7.6)	8	(5.6)	15	(10.4)	13	(9.0)	6	(4.2)	13	(9.0)	15	(10.4)	12	(8.3)	12	(8.3)	144
Portugal	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	8	(24.2)	25	(75.8)	33
Slovakia	0	(0.0)	18	(18.8)	22	(22.9)	14	(14.6)	13	(13.5)	5	(5.2)	2	(2.1)	6	(6.3)	3	(3.1)	3	(3.1)	6	(6.3)	4	(4.2)	96
Slovenia	1	(3.7)	14	(51.9)	3	(11.1)	2	(7.4)	3	(11.1)	0	(0.0)	0	(0.0)	1	(3.7)	1	(3.7)	1	(3.7)	1	(3.7)	0	(0.0)	27
Spain	6	(4.0)	12	(8.0)	7	(4.7)	14	(9.3)	12	(8.0)	20	(13.3)	15	(10.0)	6	(4.0)	7	(4.7)	16	(10.7)	22	(14.7)	13	(8.7)	150
Sweden	5	(8.8)	3	(5.3)	2	(3.5)	10	(17.5)	5	(8.8)	4	(7.0)	5	(8.8)	4	(7.0)	5	(8.8)	6	(10.5)	4	(7.0)	4	(7.0)	57
United Kingdom	1	(1.5)	6	(9.0)	8	(11.9)	2	(3.0)	7	(10.4)	6	(9.0)	8	(11.9)	4	(6.0)	5	(7.5)	7	(10.4)	6	(9.0)	7	(10.4)	67
European Union	45	(3.1)	103	(7.2)	121	(8.5)	126	(8.8)	126	(8.8)	146	(10.2)	112	(7.8)	92	(6.4)	124	(8.7)	145	(10.1)	166	(11.6)	124	(8.7)	1,430
Norway	0	(0.0)	6	(5.6)	8	(7.4)	20	(18.5)	15	(13.9)	5	(4.6)	1	(0.9)	10	(9.3)	11	(10.2)	15	(13.9)	5	(4.6)	12	(11.1)	108
Switzerland	7	(9.9)	7	(9.9)	6	(8.5)	2	(2.8)	7	(9.9)	5	(7.0)	8	(11.3)	7	(9.9)	6	(8.5)	6	(8.5)	8	(11.3)	2	(2.8)	71

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

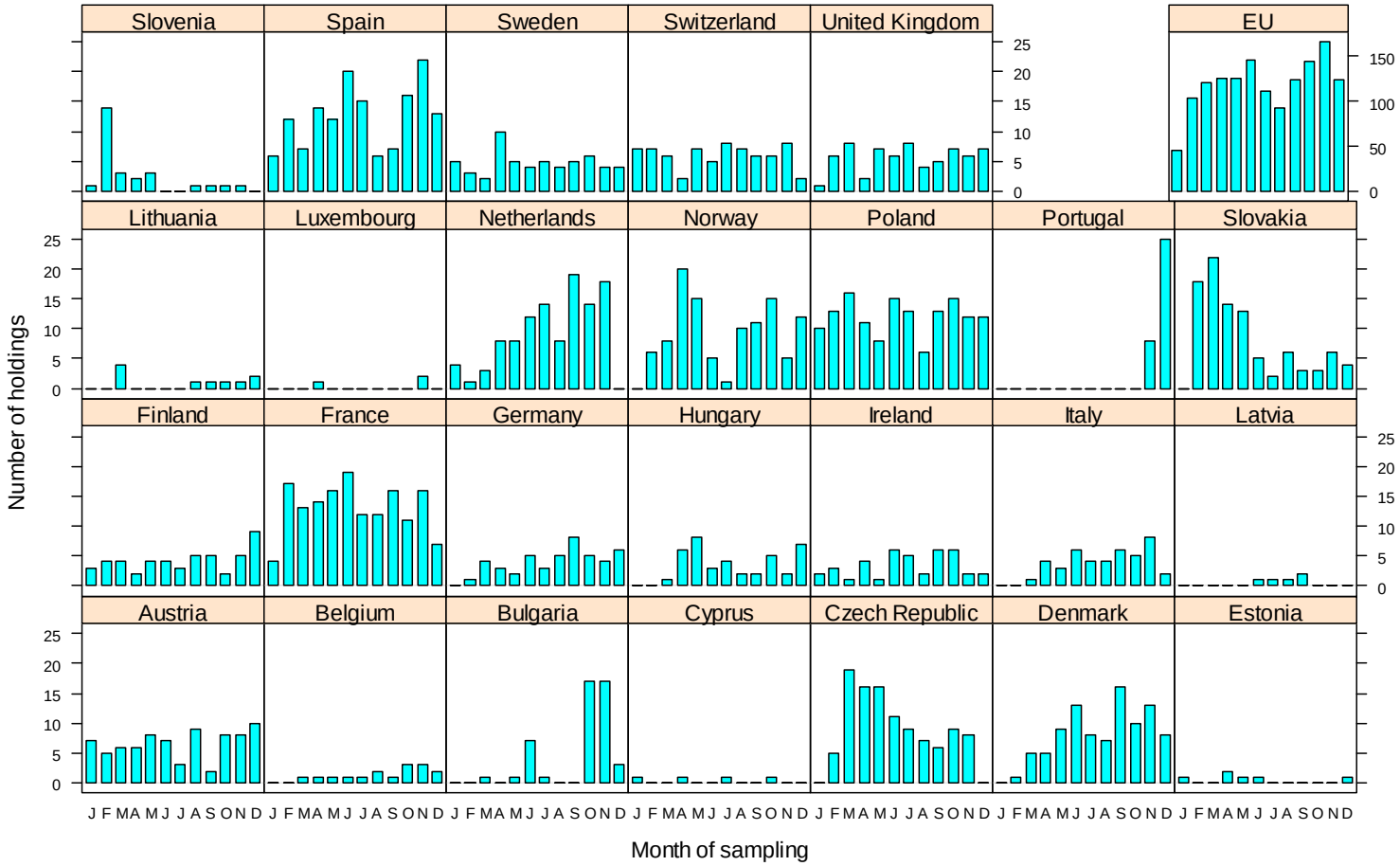

Figure 15 Distribution of the number of sampled breeding holdings by the month of sampling[(a)], *Salmonella* EU baseline survey, 2008[(b)]

(a): Holdings collected from 1 December to 15 January have been considered together in these graphs (D, in the x axis).

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 8 Number and percentage of production holdings included in the survey by the month of sampling, *Salmonella* EU baseline survey, 2008[(a)]

Member State	Month of sampling																								Total
	Jan 08		Feb 08		Mar 08		Apr 08		May 08		Jun 08		Jul 08		Aug 08		Sep 08		Oct 08		Nov 08		Dec 08		
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	
Austria	11	(6.4)	18	(10.4)	16	(9.2)	13	(7.5)	6	(3.5)	23	(13.3)	12	(6.9)	12	(6.9)	16	(9.2)	12	(6.9)	12	(6.9)	22	(12.7)	173
Belgium	0	(0.0)	0	(0.0)	16	(7.7)	10	(4.8)	14	(6.7)	12	(5.7)	13	(6.2)	14	(6.7)	31	(14.8)	40	(19.1)	37	(17.7)	22	(10.5)	209
Bulgaria	0	(0.0)	2	(8.0)	2	(8.0)	0	(0.0)	1	(4.0)	5	(20.0)	0	(0.0)	0	(0.0)	0	(0.0)	9	(36.0)	4	(16.0)	2	(8.0)	25
Cyprus	4	(6.7)	4	(6.7)	4	(6.7)	5	(8.3)	5	(8.3)	5	(8.3)	6	(10.0)	6	(10.0)	6	(10.0)	3	(5.0)	5	(8.3)	7	(11.7)	60
Czech republic	0	(0.0)	10	(6.2)	15	(9.3)	30	(18.6)	20	(12.4)	15	(9.3)	19	(11.8)	15	(9.3)	18	(11.2)	7	(4.3)	12	(7.5)	0	(0.0)	161
Denmark	1	(0.5)	6	(3.0)	13	(6.6)	14	(7.1)	14	(7.1)	17	(8.6)	7	(3.5)	10	(5.1)	20	(10.1)	29	(14.6)	33	(16.7)	34	(17.2)	198
Estonia	2	(7.1)	3	(10.7)	3	(10.7)	1	(3.6)	2	(7.1)	2	(7.1)	3	(10.7)	2	(7.1)	4	(14.3)	2	(7.1)	3	(10.7)	1	(3.6)	28
Finland	7	(4.5)	13	(8.3)	9	(5.7)	15	(9.6)	6	(3.8)	16	(10.2)	13	(8.3)	11	(7.0)	14	(8.9)	20	(12.7)	9	(5.7)	24	(15.3)	157
France	6	(3.2)	15	(8.1)	18	(9.7)	19	(10.2)	15	(8.1)	16	(8.6)	22	(11.8)	14	(7.5)	18	(9.7)	19	(10.2)	15	(8.1)	9	(4.8)	186
Germany	3	(1.9)	1	(0.6)	12	(7.7)	6	(3.9)	3	(1.9)	20	(12.9)	10	(6.5)	6	(3.9)	23	(14.8)	31	(20.0)	24	(15.5)	16	(10.3)	155
Hungary	0	(0.0)	1	(0.7)	15	(10.6)	12	(8.5)	12	(8.5)	12	(8.5)	8	(5.7)	13	(9.2)	18	(12.8)	10	(7.1)	7	(5.0)	33	(23.4)	141
Ireland	8	(5.4)	9	(6.0)	8	(5.4)	14	(9.4)	13	(8.7)	10	(6.7)	7	(4.7)	8	(5.4)	11	(7.4)	17	(11.4)	35	(23.5)	9	(6.0)	149
Italy	0	(0.0)	0	(0.0)	4	(2.3)	5	(2.9)	11	(6.4)	24	(14.0)	9	(5.3)	15	(8.8)	24	(14.0)	30	(17.5)	32	(18.7)	17	(9.9)	171
Latvia	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	4	(14.3)	7	(25.0)	3	(10.7)	3	(10.7)	4	(14.3)	2	(7.1)	4	(14.3)	1	(3.6)	28
Lithuania	0	(0.0)	0	(0.0)	25	(34.7)	3	(4.2)	5	(6.9)	3	(4.2)	6	(8.3)	3	(4.2)	6	(8.3)	7	(9.7)	8	(11.1)	6	(8.3)	72
Luxembourg	3	(7.3)	3	(7.3)	3	(7.3)	3	(7.3)	3	(7.3)	4	(9.8)	4	(9.8)	4	(9.8)	5	(12.2)	4	(9.8)	3	(7.3)	2	(4.9)	41
Netherlands	5	(2.4)	6	(2.8)	6	(2.8)	15	(7.1)	26	(12.3)	14	(6.6)	19	(9.0)	19	(9.0)	21	(9.9)	37	(17.5)	41	(19.3)	3	(1.4)	212
Poland	10	(5.6)	20	(11.2)	10	(5.6)	16	(9.0)	12	(6.7)	15	(8.4)	14	(7.9)	11	(6.2)	13	(7.3)	21	(11.8)	12	(6.7)	24	(13.5)	178
Portugal	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	18	(13.4)	116	(86.6)	134
Slovakia	0	(0.0)	3	(3.1)	2	(2.1)	1	(1.0)	2	(2.1)	16	(16.7)	15	(15.6)	11	(11.5)	11	(11.5)	12	(12.5)	10	(10.4)	13	(13.5)	96
Slovenia	2	(2.3)	10	(11.5)	12	(13.8)	9	(10.3)	12	(13.8)	8	(9.2)	6	(6.9)	4	(4.6)	4	(4.6)	9	(10.3)	9	(10.3)	2	(2.3)	87
Spain	5	(2.4)	28	(13.4)	11	(5.3)	19	(9.1)	23	(11.0)	13	(6.2)	22	(10.5)	17	(8.1)	27	(12.9)	25	(12.0)	12	(5.7)	7	(3.3)	209
Sweden	12	(8.0)	16	(10.7)	15	(10.0)	7	(4.7)	13	(8.7)	15	(10.0)	9	(6.0)	13	(8.7)	13	(8.7)	12	(8.0)	11	(7.3)	14	(9.3)	150
United Kingdom	6	(3.1)	7	(3.7)	9	(4.7)	9	(4.7)	11	(5.8)	12	(6.3)	17	(8.9)	16	(8.4)	18	(9.4)	25	(13.1)	37	(19.4)	24	(12.6)	191
European Union	85	(2.6)	175	(5.5)	228	(7.1)	226	(7.0)	233	(7.3)	284	(8.8)	244	(7.6)	227	(7.1)	325	(10.1)	383	(11.9)	393	(12.2)	408	(12.7)	3,211
Norway	0	(0.0)	22	(15.4)	11	(7.7)	24	(16.8)	9	(6.3)	10	(7.0)	2	(1.4)	12	(8.4)	20	(14.0)	12	(8.4)	14	(9.8)	7	(4.9)	143
Switzerland	4	(2.6)	14	(9.1)	11	(7.1)	15	(9.7)	13	(8.4)	16	(10.4)	17	(11.0)	13	(8.4)	15	(9.7)	16	(10.4)	13	(8.4)	7	(4.5)	154

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

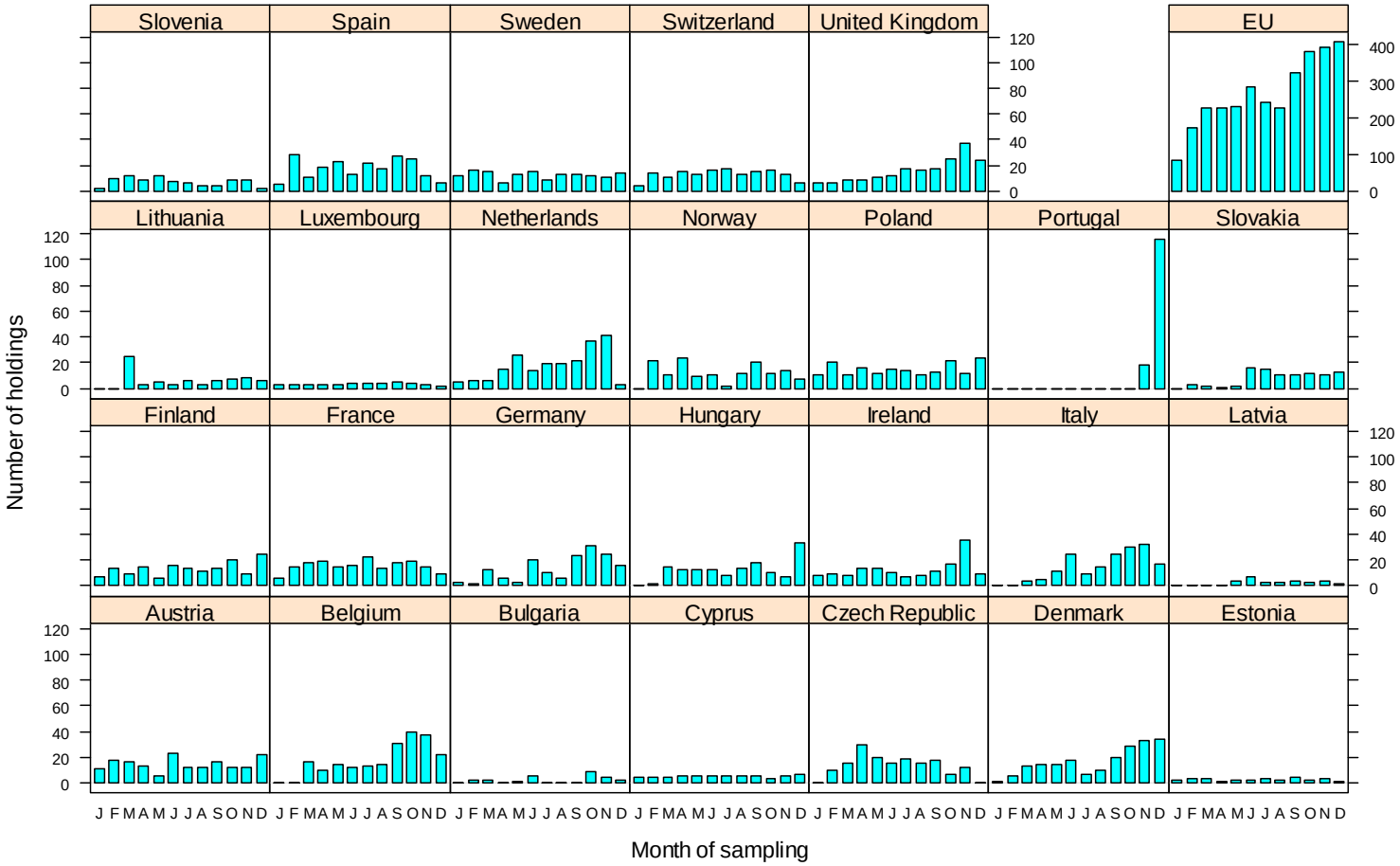

Figure 16 Distribution of the number of sampled production holdings by the month of sampling[(a)], *Salmonella* EU baseline survey, 2008[(b)]

(a): Holdings collected from 1 December to 15 January have been considered together in these graphs (D, in the x axis).

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 9 Distribution of the number of sampled breeding holdings by the size of the holding, *Salmonella* EU baseline survey, 2008[(a)]

Member State	Size of the holding										Total
	<50		50-99		100-399		400-999		>999		
	N	%	N	%	N	%	N	%	N	%	N
Austria	14	*18*	36	*46*	26	*33*	2	*3*	1	*1*	79
Belgium	0	*0*	1	*6*	15	*94*	0	*0*	0	*0*	16
Bulgaria	4	*9*	7	*15*	10	*21*	5	*11*	21	*45*	47
Cyprus	0	*0*	0	*0*	1	*25*	1	*25*	2	*50*	4
Czech Republic	0	*0*	8	*8*	26	*25*	26	*25*	46	*43*	106
Denmark	0	*0*	1	*1*	39	*41*	49	*52*	6	*6*	95
Estonia	0	*0*	0	*0*	5	*83*	1	*17*	0	*0*	6
Finland	0	*0*	21	*42*	24	*48*	4	*8*	1	*2*	50
France	1	*1*	20	*13*	121	*77*	15	*10*	0	*0*	157
Germany	0	*0*	3	*7*	23	*50*	13	*28*	7	*15*	46
Hungary	1	*3*	3	*8*	14	*35*	14	*35*	8	*20*	40
Ireland	2	*5*	8	*20*	15	*38*	14	*35*	1	*3*	40
Italy	0	*0*	2	*5*	18	*42*	14	*33*	9	*21*	43
Latvia	0	*0*	0	*0*	2	*40*	1	*20*	2	*40*	5
Lithuania	0	*0*	0	*0*	5	*50*	3	*30*	2	*20*	10
Luxembourg	0	*0*	1	*33*	1	*33*	1	*33*	0	*0*	3
Netherlands	0	*0*	6	*6*	73	*67*	24	*22*	6	*6*	109
Poland	23	*16*	26	*18*	66	*46*	18	*13*	11	*8*	144
Portugal	0	*0*	0	*0*	15	*45*	17	*52*	1	*3*	33
Slovakia	3	*3*	19	*20*	58	*60*	13	*14*	3	*3*	96
Slovenia	4	*15*	16	*59*	7	*26*	0	*0*	0	*0*	27
Spain	0	*0*	11	*7*	54	*36*	47	*31*	38	*25*	150
Sweden	1	*2*	10	*18*	42	*74*	4	*7*	0	*0*	57
United Kingdom	0	*0*	4	*6*	20	*30*	36	*54*	7	*10*	67
European Union (24MSs)	53	*4*	203	*14*	680	*48*	322	*23*	172	*12*	1,430
Norway	26	*24*	48	*44*	33	*31*	1	*1*	0	*0*	108
Switzerland	0	*0*	45	*63*	26	*37*	0	*0*	0	*0*	71

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

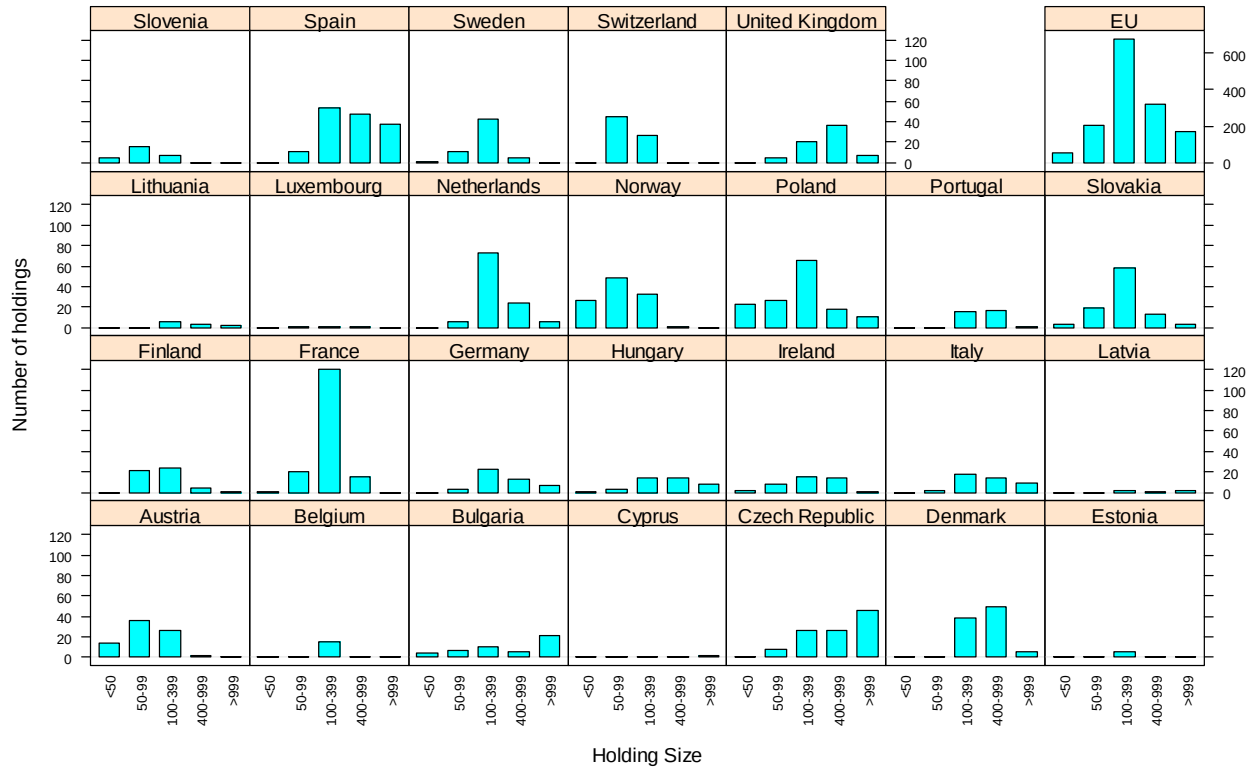

Figure 17 Distribution of the number of sampled breeding holdings by the size of the holding, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 10 Distribution of the number of sampled production holdings by the size of the holding, *Salmonella* EU baseline survey, 2008[(a)]

Member State	Size of the holding										Total
	<50		50-99		100-399		400-999		>999		
	N	%	N	%	N	%	N	%	N	%	N
Austria	38	*22*	105	*61*	29	*17*	1	*1*	0	*0*	173
Belgium	1	*0*	46	*22*	153	*73*	9	*4*	0	*0*	209
Bulgaria	1	*4*	7	*28*	4	*16*	5	*20*	8	*32*	25
Cyprus	0	*0*	2	*3*	28	*47*	22	*37*	8	*13*	60
Czech Republic	1	*1*	1	*1*	23	*14*	35	*22*	101	*63*	161
Denmark	3	*2*	11	*6*	79	*40*	84	*42*	21	*11*	198
Estonia	0	*0*	0	*0*	14	*50*	12	*43*	2	*7*	28
Finland	8	*5*	68	*43*	66	*42*	10	*6*	5	*3*	157
France	1	*1*	41	*22*	130	*70*	11	*6*	3	*2*	186
Germany	0	*0*	22	*14*	103	*66*	15	*10*	15	*10*	155
Hungary	0	*0*	0	*0*	20	*14*	47	*33*	74	*52*	141
Ireland	1	*1*	20	*13*	75	*50*	44	*30*	9	*6*	149
Italy	2	*1*	21	*12*	76	*44*	51	*30*	21	*12*	171
Latvia	0	*0*	0	*0*	14	*50*	5	*18*	9	*32*	28
Lithuania	0	*0*	0	*0*	21	*29*	18	*25*	33	*46*	72
Luxembourg	14	*34*	13	*32*	12	*29*	2	*5*	0	*0*	41
Netherlands	0	*0*	4	*2*	104	*49*	88	*42*	16	*8*	212
Poland	21	*12*	30	*17*	81	*46*	23	*13*	23	*13*	178
Portugal	3	*2*	24	*18*	92	*69*	14	*10*	1	*1*	134
Slovakia	10	*10*	31	*32*	42	*44*	10	*10*	3	*3*	96
Slovenia	40	*46*	35	*40*	5	*6*	1	*1*	6	*7*	87
Spain	0	*0*	35	*17*	72	*34*	56	*27*	46	*22*	209
Sweden	17	*11*	50	*33*	61	*41*	17	*11*	5	*3*	150
United Kingdom	0	*0*	21	*11*	84	*44*	70	*37*	16	*8*	191
European Union (24 MSs)	161	*5*	587	*18*	1,388	*43*	650	*20*	425	*13*	3,211
Norway	69	*48*	56	*39*	15	*10*	3	*2*	0	*0*	143
Switzerland	0	*0*	101	*66*	51	*33*	2	*1*	0	*0*	154

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

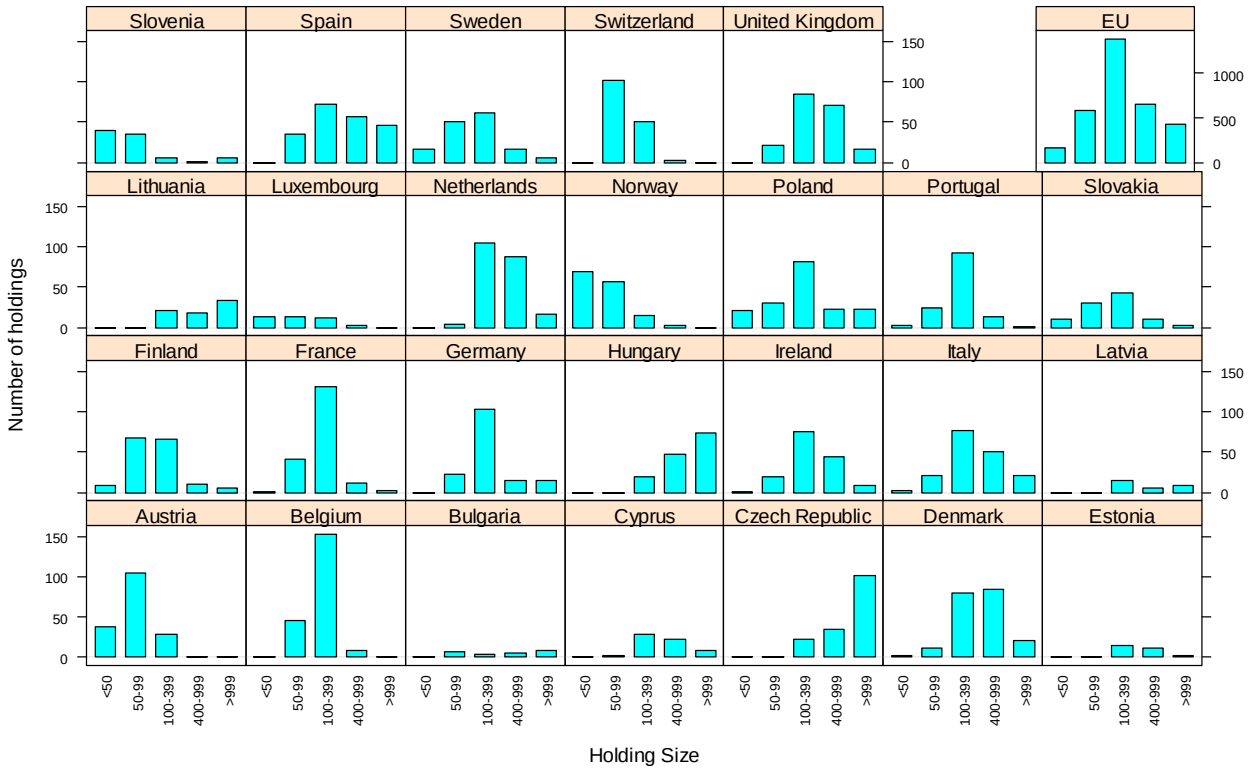

Figure 18 Distribution of the number of sampled production holdings by the size of the holding, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 11 Distribution of the number of pooled samples by the number of days between the sampling date and the starting date of detection testing for *Salmonella*, *Salmonella* EU baseline survey, 2008[(a)]

Member State	Number of days between sampling date and starting date of detection																Total
	0		1		2		3		4		5		6		7		
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N
Austria	30	*1*	960	*38*	990	*39*	80	*3*	250	*10*	110	*4*	70	*3*	30	*1*	2,520
Belgium	10	*0*	101	*4*	2,018	*90*	50	*2*	71	*3*	0	*0*	0	*0*	0	*0*	2,250
Bulgaria	62	*9*	268	*37*	140	*19*	150	*21*	20	*3*	10	*1*	20	*3*	50	*7*	720
Cyprus	419	*65*	199	*31*	11	*2*	10	*2*	0	*0*	0	*0*	0	*0*	1	*0*	640
Czech republic	1,060	*40*	1,310	*49*	247	*9*	52	*2*	1	*0*	0	*0*	0	*0*	0	*0*	2,670
Denmark	10	*0*	1,878	*64*	850	*29*	130	*4*	50	*2*	0	*0*	12	*0*	0	*0*	2,930
Estonia	81	*24*	189	*56*	50	*15*	0	*0*	20	*6*	0	*0*	0	*0*	0	*0*	340
Finland	2	*0*	1,418	*69*	610	*29*	40	*2*	0	*0*	0	*0*	0	*0*	0	*0*	2,070
France	40	*1*	1,200	*35*	1,100	*32*	710	*21*	290	*8*	40	*1*	40	*1*	10	*0*	3,430
Germany	540	*27*	1,120	*56*	270	*13*	60	*3*	10	*0*	0	*0*	10	*0*	0	*0*	2,010
Hungary	340	*19*	1,140	*63*	260	*14*	60	*3*	10	*1*	0	*0*	0	*0*	0	*0*	1,810
Ireland	50	*3*	1,270	*67*	370	*20*	40	*2*	80	*4*	40	*2*	20	*1*	20	*1*	1,890
Italy	767	*36*	751	*35*	220	*10*	161	*8*	111	*5*	50	*2*	30	*1*	50	*2*	2,140
Latvia	40	*12*	140	*42*	100	*30*	10	*3*	40	*12*	0	*0*	0	*0*	0	*0*	330
Lithuania	160	*20*	600	*73*	60	*7*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	820
Luxembourg	170	*39*	270	*61*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	0	*0*	440
Netherlands	490	*15*	2,350	*73*	350	*11*	10	*0*	0	*0*	0	*0*	0	*0*	10	*0*	3,210
Poland	291	*9*	1,950	*61*	779	*24*	130	*4*	40	*1*	10	*0*	20	*1*	0	*0*	3,220
Portugal	270	*16*	740	*44*	500	*30*	110	*7*	40	*2*	0	*0*	10	*1*	0	*0*	1,670
Slovakia	639	*33*	1,161	*60*	100	*5*	20	*1*	0	*0*	0	*0*	0	*0*	0	*0*	1,920
Slovenia	40	*4*	870	*76*	140	*12*	10	*1*	80	*7*	0	*0*	0	*0*	0	*0*	1,140
Spain	11	*0*	0	*0*	10	*0*	1,669	*46*	1,760	*49*	100	*3*	20	*1*	20	*1*	3,590
Sweden	51	*2*	1,397	*67*	470	*23*	110	*5*	10	*0*	0	*0*	22	*1*	10	*0*	2,070
United Kingdom	160	*6*	1,600	*62*	620	*24*	140	*5*	60	*2*	0	*0*	0	*0*	0	*0*	2,580
European Union	5,733	*12*	22,882	*49*	10,265	*22*	3,752	*8*	2,943	*6*	360	*1*	274	*1*	201	*0*	46,410
Norway	118	*5*	1,584	*63*	508	*20*	250	*10*	40	*2*	10	*0*	0	*0*	0	*0*	2,510
Switzerland	20	*1*	1,790	*80*	20	*1*	380	*17*	30	*1*	0	*0*	10	*0*	0	*0*	2,250

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

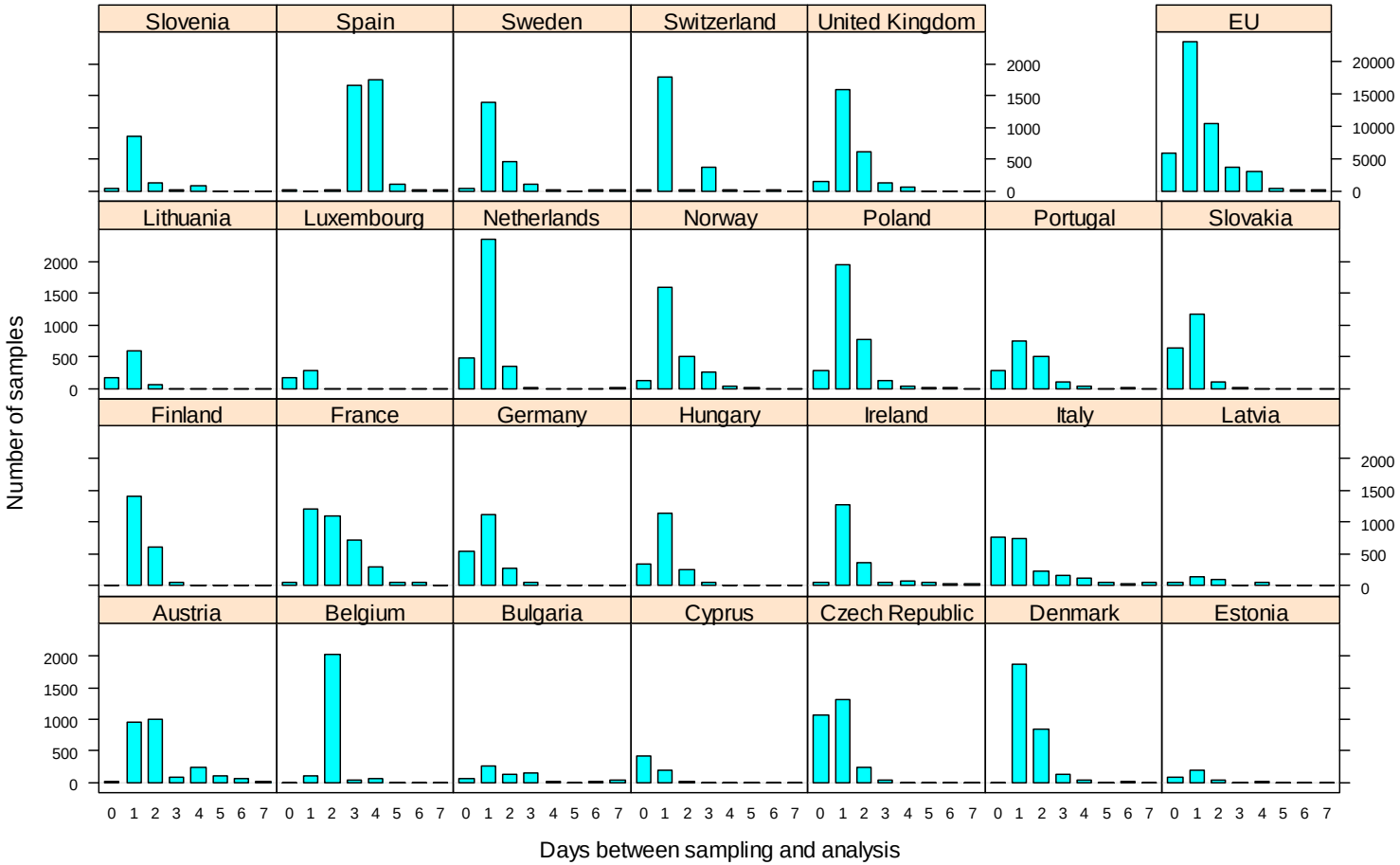

Figure 19 Distribution of the number of pooled samples by the number of days between the sampling date and the starting date of detection testing for *Salmonella* in holdings with breeding pigs, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

F PROPORTION (%) OF *SALMONELLA*-POSITIVE BREEDING HOLDINGS, IN THE *SALMONELLA* BASELINE SURVEY IN HOLDINGS WITH BREEDING PIGS

Table 12 Number and proportions (%) of *Salmonella*-positive breeding holdings [(a)], *Salmonella* EU baseline survey, 2008[(b)]

Member State	Total holdings	*Salmonella*		*S.* Typhimurium		*S.* Derby		Serovars other than *S.* Typhimurium and *S.* Derby	
		N positive	% positive	N positive	% positive	N positive	% positive	N positive	% positive
Austria	79	5	6.3	3	3.8	1	1.3	1	1.3
Belgium	16	3	18.8	2	12.5	1	6.3	1	6.3
Bulgaria	47	1	2.1	0	0.0	0	0.0	1	2.1
Cyprus	4	2	50.0	0	0.0	1	25.0	1	25.0
Czech republic	106	11	10.4	4	3.8	1	0.9	6	5.7
Denmark	95	39	41.1	15	15.8	12	12.6	17	17.9
Estonia	6	0	0.0	0	0.0	0	0.0	0	0.0
Finland	50	0	0.0	0	0.0	0	0.0	0	0.0
France	157	79	50.3	11	7.0	40	25.5	42	26.8
Germany	46	13	28.3	4	8.7	5	10.9	3	6.5
Hungary	40	12	30.0	4	10.0	3	7.5	6	15.0
Ireland	40	21	52.5	7	17.5	8	20.0	7	17.5
Italy	43	22	51.2	3	7.0	7	16.3	7	16.3
Latvia	5	1	20.0	0	0.0	1	20.0	1	20.0
Lithuania	10	0	0.0	0	0.0	0	0.0	0	0.0
Luxembourg	3	1	33.3	0	0.0	0	0.0	1	33.3
Netherlands	109	63	57.8	15	13.8	20	18.3	42	38.5
Poland	144	10	6.9	4	2.8	2	1.4	5	3.5
Portugal	33	15	45.5	3	9.1	3	9.1	11	33.3
Slovakia	96	11	11.5	2	2.1	3	3.1	6	6.3
Slovenia	27	0	0.0	0	0.0	0	0.0	0	0.0
Spain	150	96	64.0	21	14.0	15	10.0	80	53.3
Sweden	57	1	1.8	1	1.8	0	0.0	0	0.0
United Kingdom	67	35	52.2	13	19.4	10	14.9	20	29.9
European Union	1,430	441	30.8	112	7.8	133	9.3	258	18.0
Norway	108	0	0.0	0	0.0	0	0.0	0	0.0
Switzerland	71	11	15.5	3	4.2	1	1.4	6	8.5

(a): One holding can be positive for more than one serovar.

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

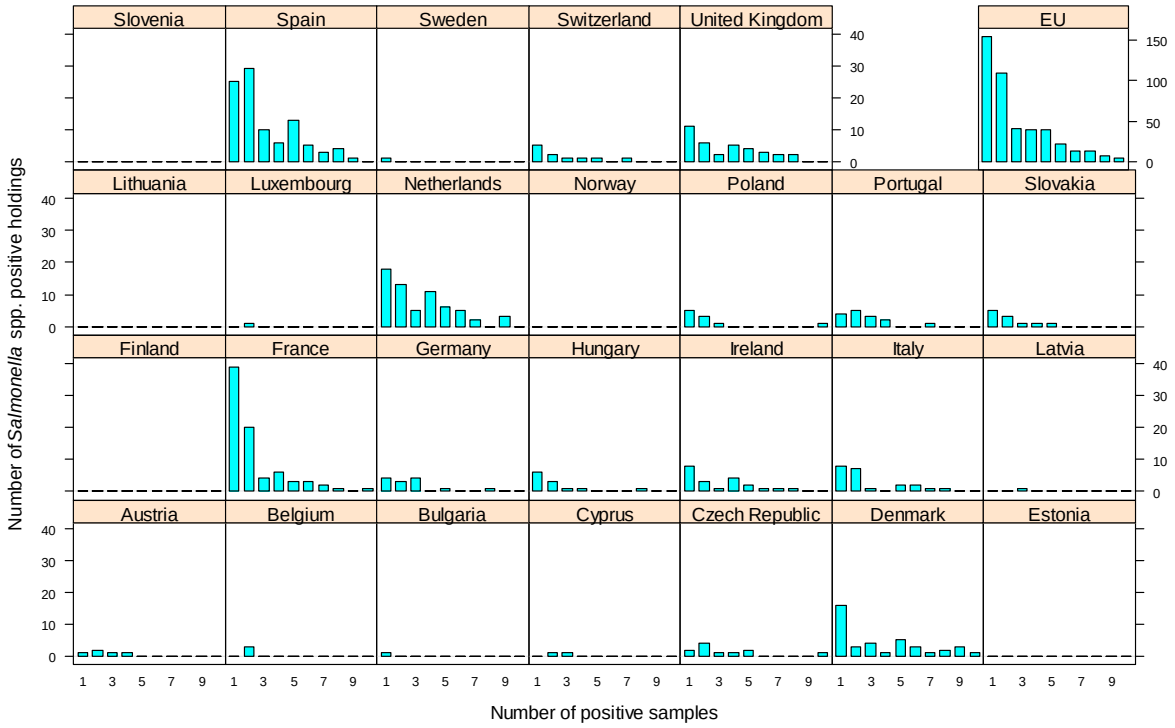

Figure 20 Distribution of the number of positive samples in *Salmonella*-positive breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 13 Number and proportions (%) of *Salmonella*-positive production holdings[a], *Salmonella* EU baseline survey, 2008[b]

Member State	Total holdings	*Salmonella*		*S.* Typhimurium		*S.* Derby		Serovars other than *S.* Typhimurium and *S.* Derby	
		N positive	% positive	N positive	% positive	N positive	% positive	N positive	% positive
Austria	173	10	5.8	0	0.0	1	0.6	9	5.2
Belgium	209	76	36.4	23	11.0	21	10.0	45	21.5
Bulgaria	25	0	0.0	0	0.0	0	0.0	0	0.0
Cyprus	60	11	18.3	0	0.0	5	8.3	5	8.3
Czech Republic	161	25	15.5	4	2.5	6	3.7	18	11.2
Denmark	198	82	41.4	25	12.6	29	14.6	37	18.7
Estonia	28	1	3.6	0	0.0	0	0.0	0	0.0
Finland	157	0	0.0	0	0.0	0	0.0	0	0.0
France	186	72	38.7	6	3.2	38	20.4	37	19.9
Germany	155	32	20.6	5	3.2	13	8.4	14	9.0
Hungary	141	39	27.7	2	1.4	18	12.8	20	14.2
Ireland	149	71	47.7	26	17.4	20	13.4	39	26.2
Italy	171	75	43.9	10	5.8	21	12.3	20	11.7
Latvia	28	8	28.6	0	0.0	1	3.6	7	25.0
Lithuania	72	6	8.3	0	0.0	0	0.0	6	8.3
Luxembourg	41	9	22.0	1	2.4	7	17.1	3	7.3
Netherlands	212	118	55.7	17	8.0	36	17.0	90	42.5
Poland	178	17	9.6	3	1.7	5	2.8	9	5.1
Portugal	134	58	43.3	18	13.4	7	5.2	40	29.9
Slovakia	96	18	18.8	3	3.1	4	4.2	13	13.5
Slovenia	87	9	10.3	0	0.0	1	1.1	9	10.3
Spain	209	111	53.1	26	12.4	14	6.7	89	42.6
Sweden	150	0	0.0	0	0.0	0	0.0	0	0.0
United Kingdom	191	84	44.0	19	9.9	21	11.0	61	31.9
European Union	3,211	932	29.0	188	5.9	268	8.3	571	17.8
Norway	143	0	0.0	0	0.0	0	0.0	0	0.0
Switzerland	154	18	11.7	3	1.9	3	1.9	12	7.8

(a): One holding can be positive for more than one serovar.

(b): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

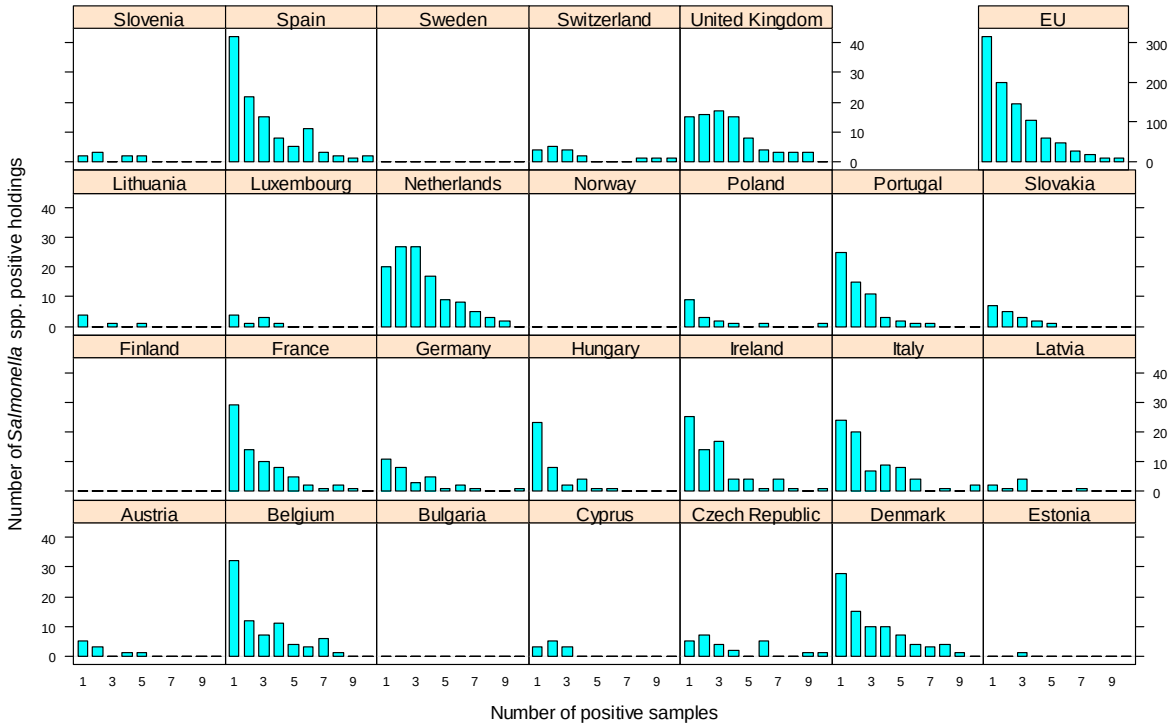

Figure 21 Distribution of the number of positive samples in *Salmonella*-positive production holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

G PREVALENCE OF *SALMONELLA*-POSITIVE BREEDING HOLDINGS

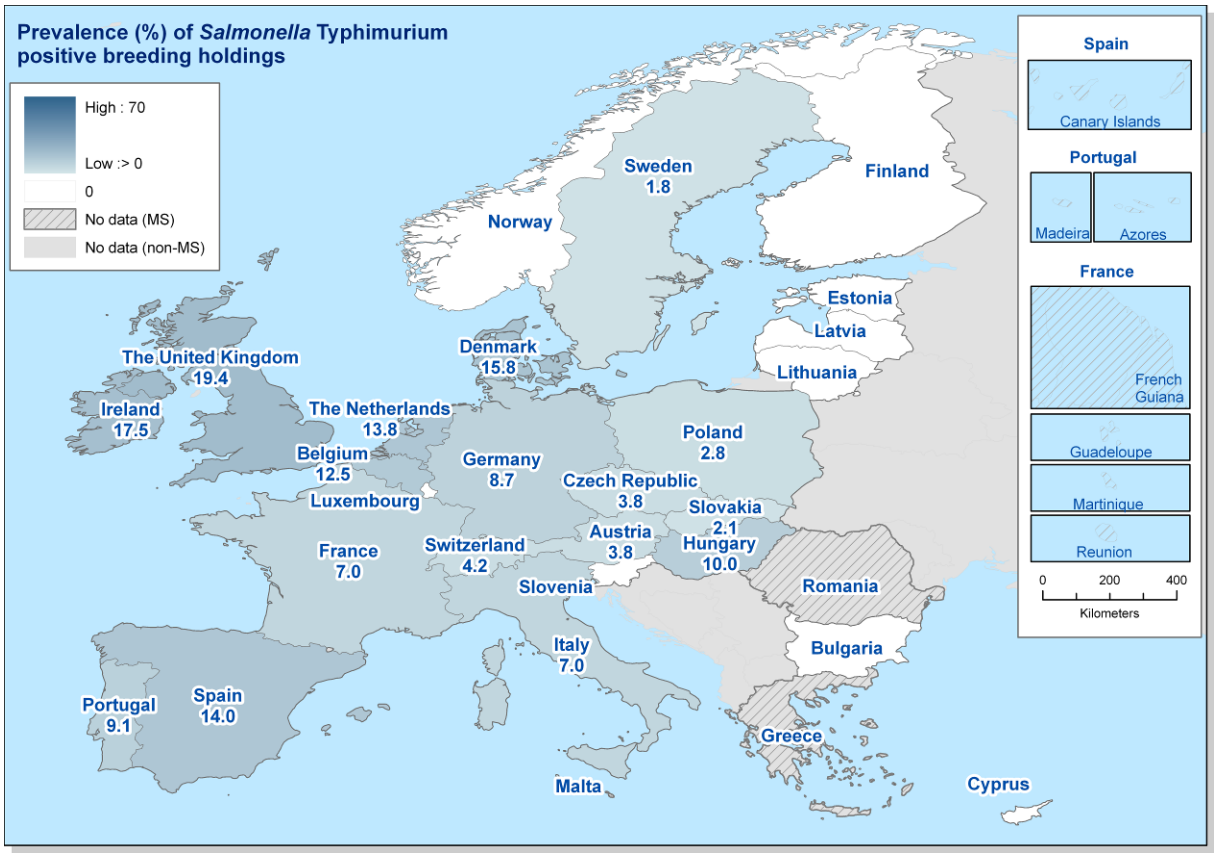

Figure 22 Prevalence of *Salmonella* Typhimurium-positive breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

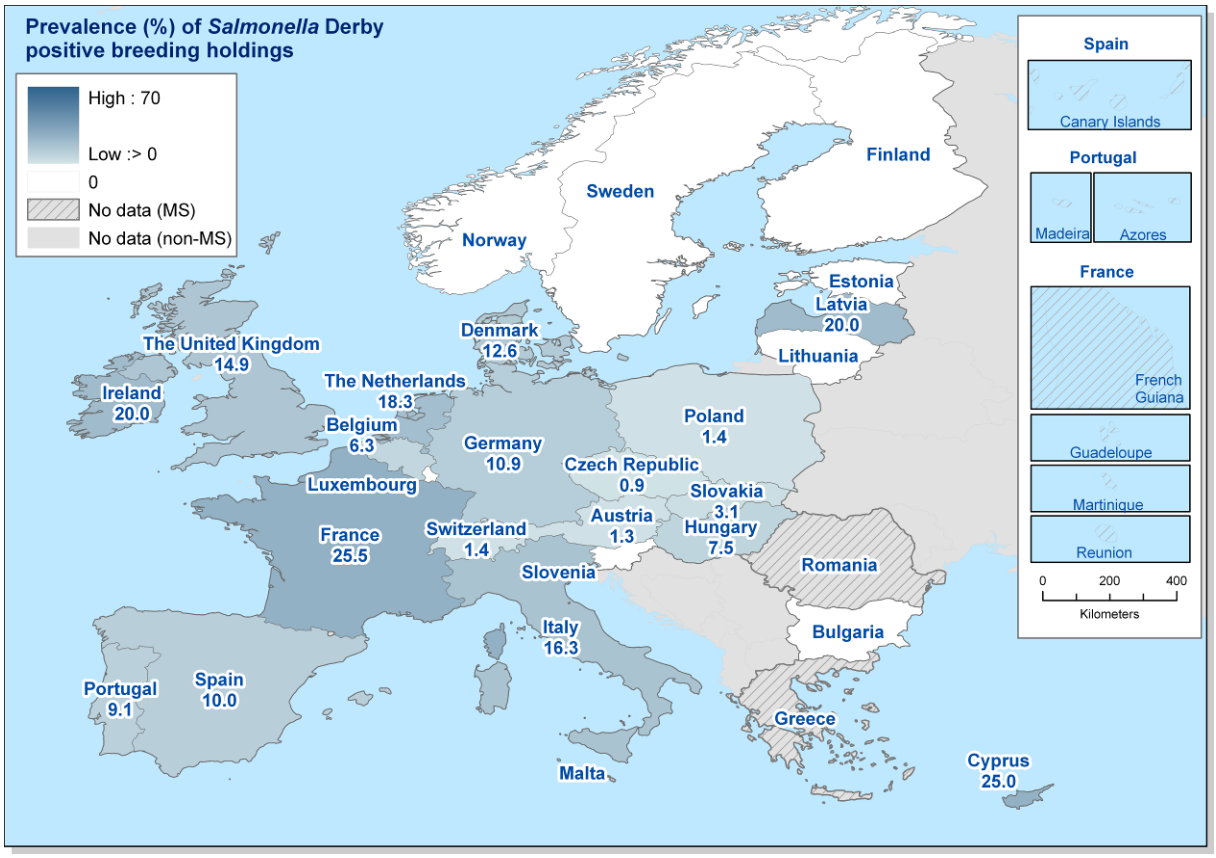

Figure 23 Prevalence of *Salmonella* Derby-positive breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

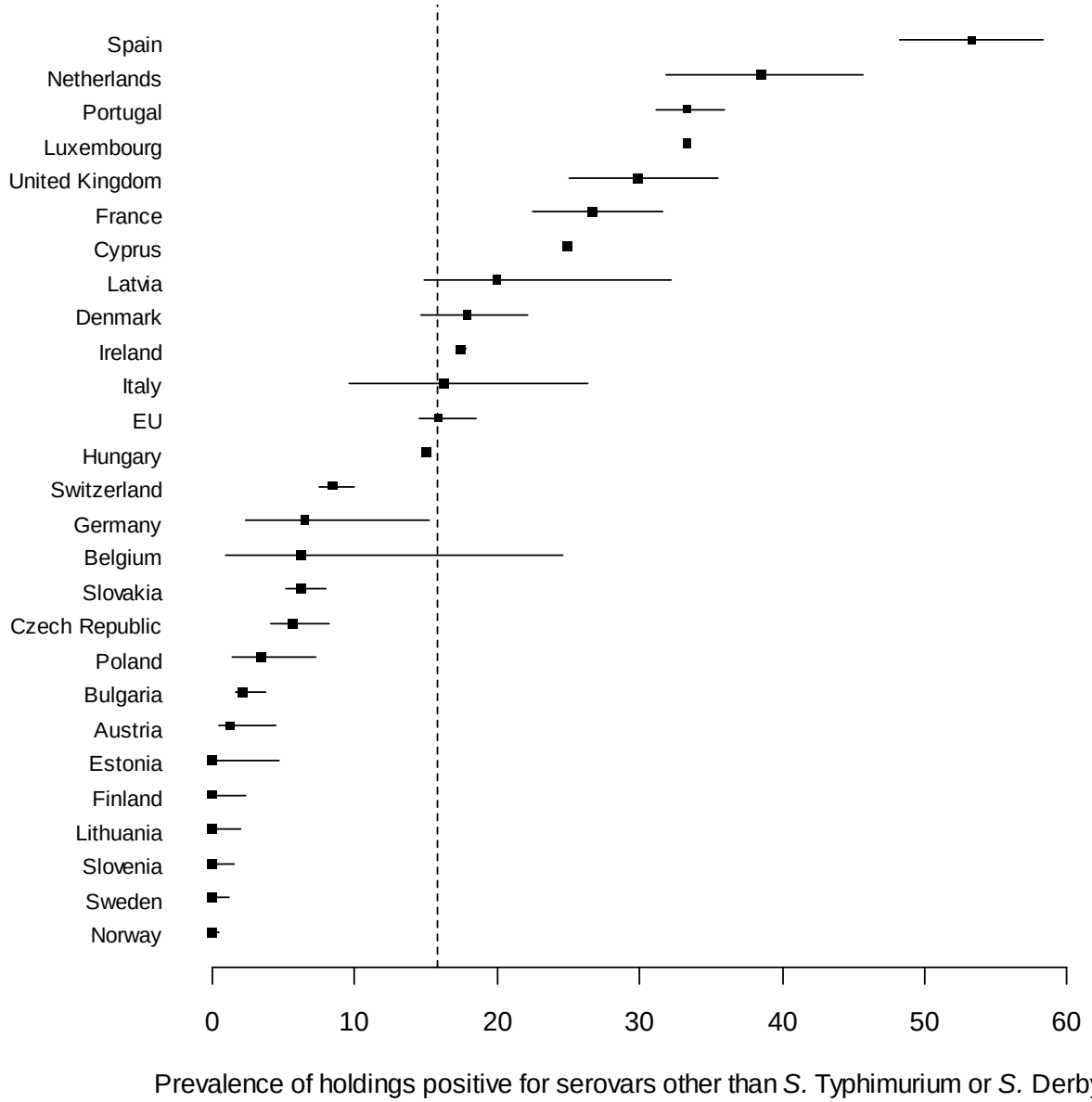

Figure 24 Prevalence[(a)] of breeding holdings positive to serovars other than *Salmonella* Typhimurium or *Salmonella* Derby, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing breeding holdings are included in the survey in Cyprus, Hungary, and Luxembourg (census sampling), a 95% CI based on a finite population approach is equal to the point estimate and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

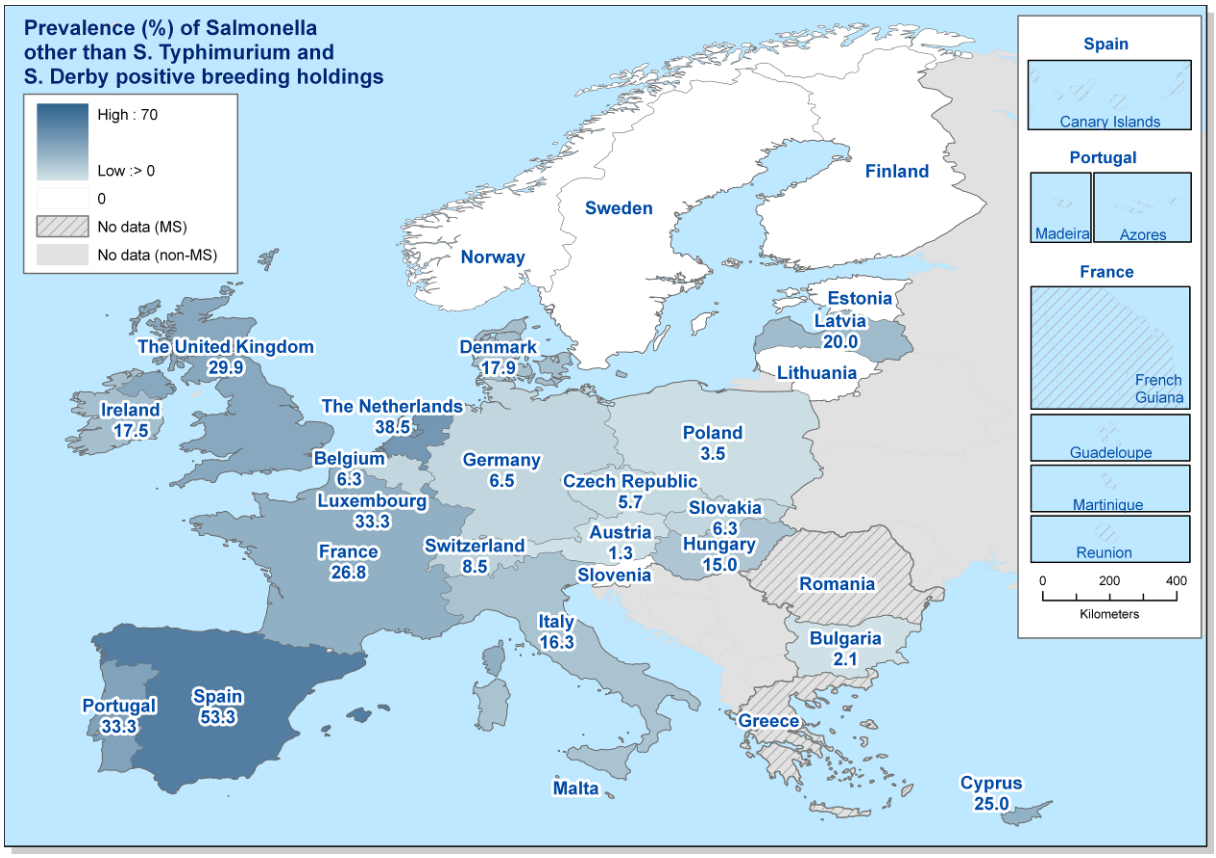

Figure 25 Prevalence of breeding holdings positive to serovars other than *Salmonella* Typhimurium or *Salmonella* Derby, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

H PREVALENCE OF *SALMONELLA*-POSITIVE PRODUCTION HOLDINGS

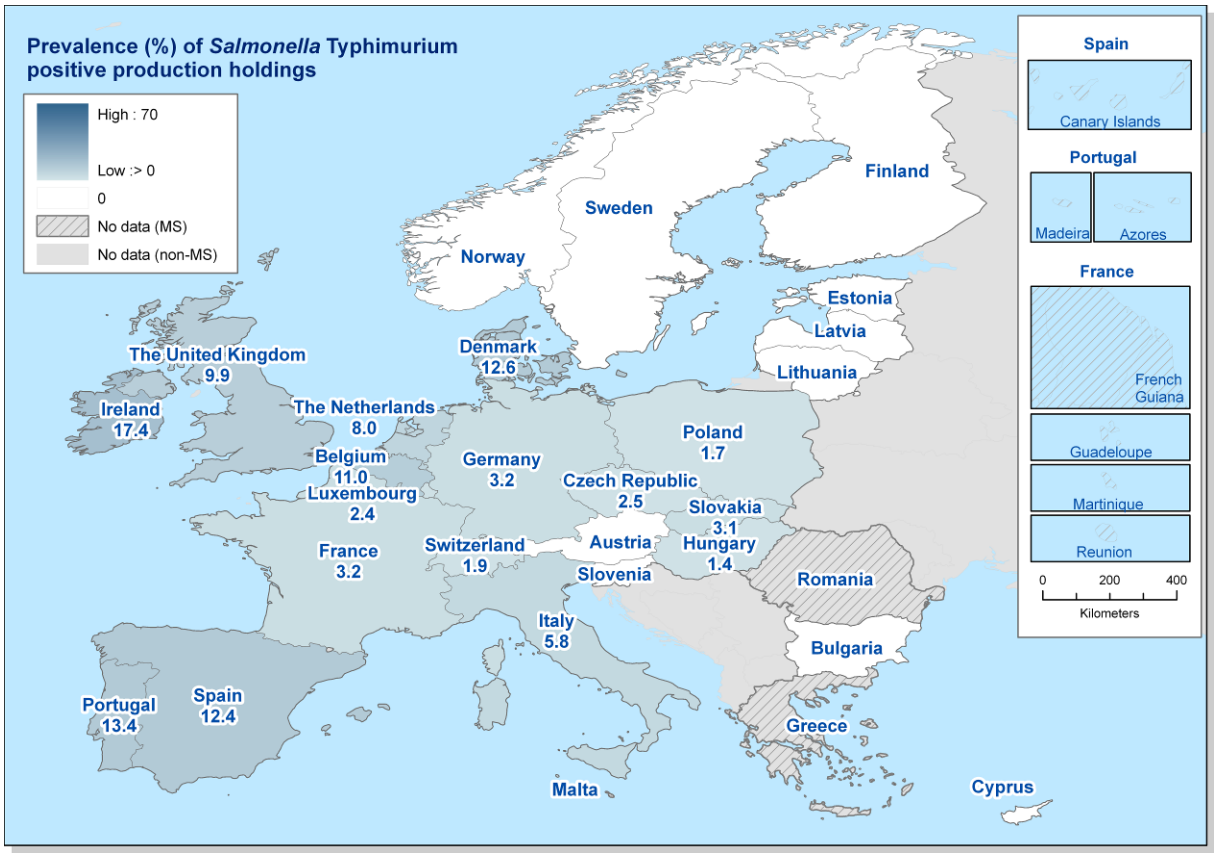

Figure 26 Prevalence of *Salmonella* Typhimurium-positive production holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

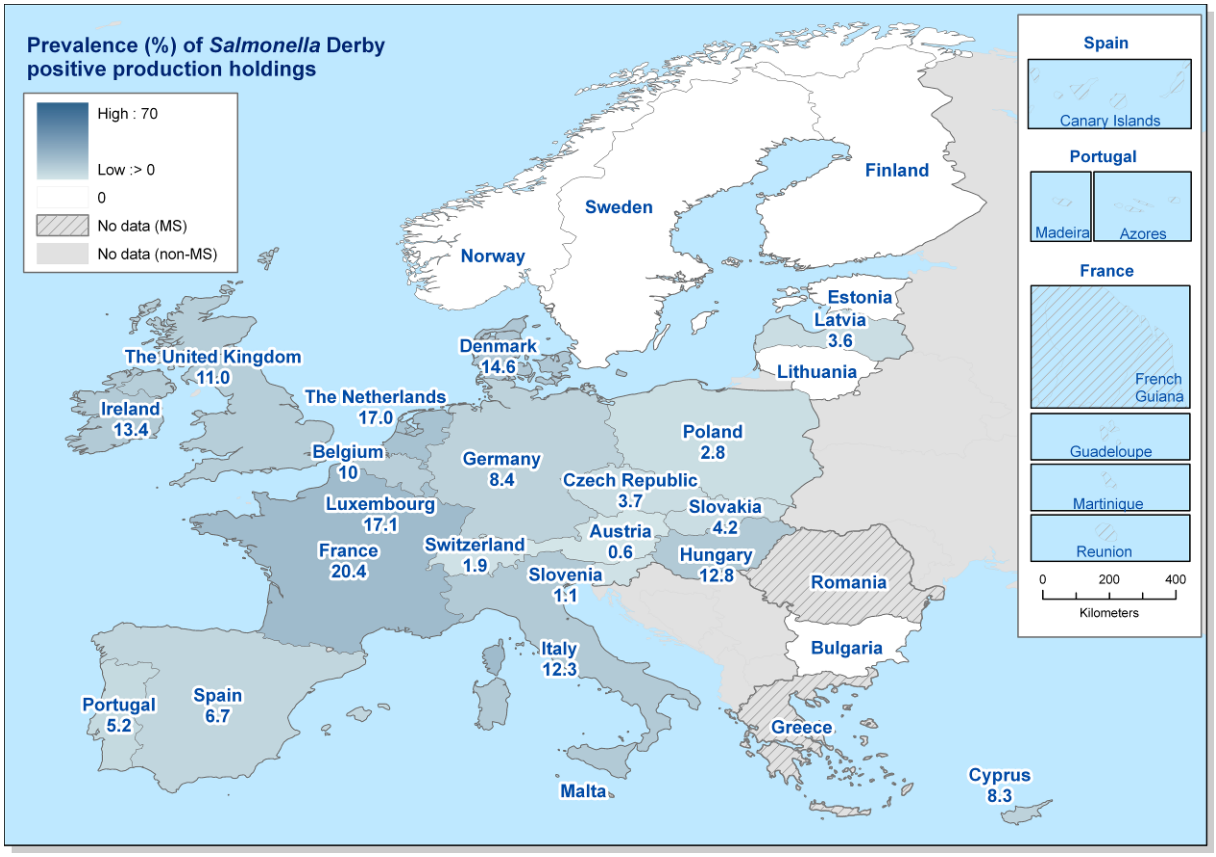

Figure 27 Prevalence of *Salmonella* Derby-positive production holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

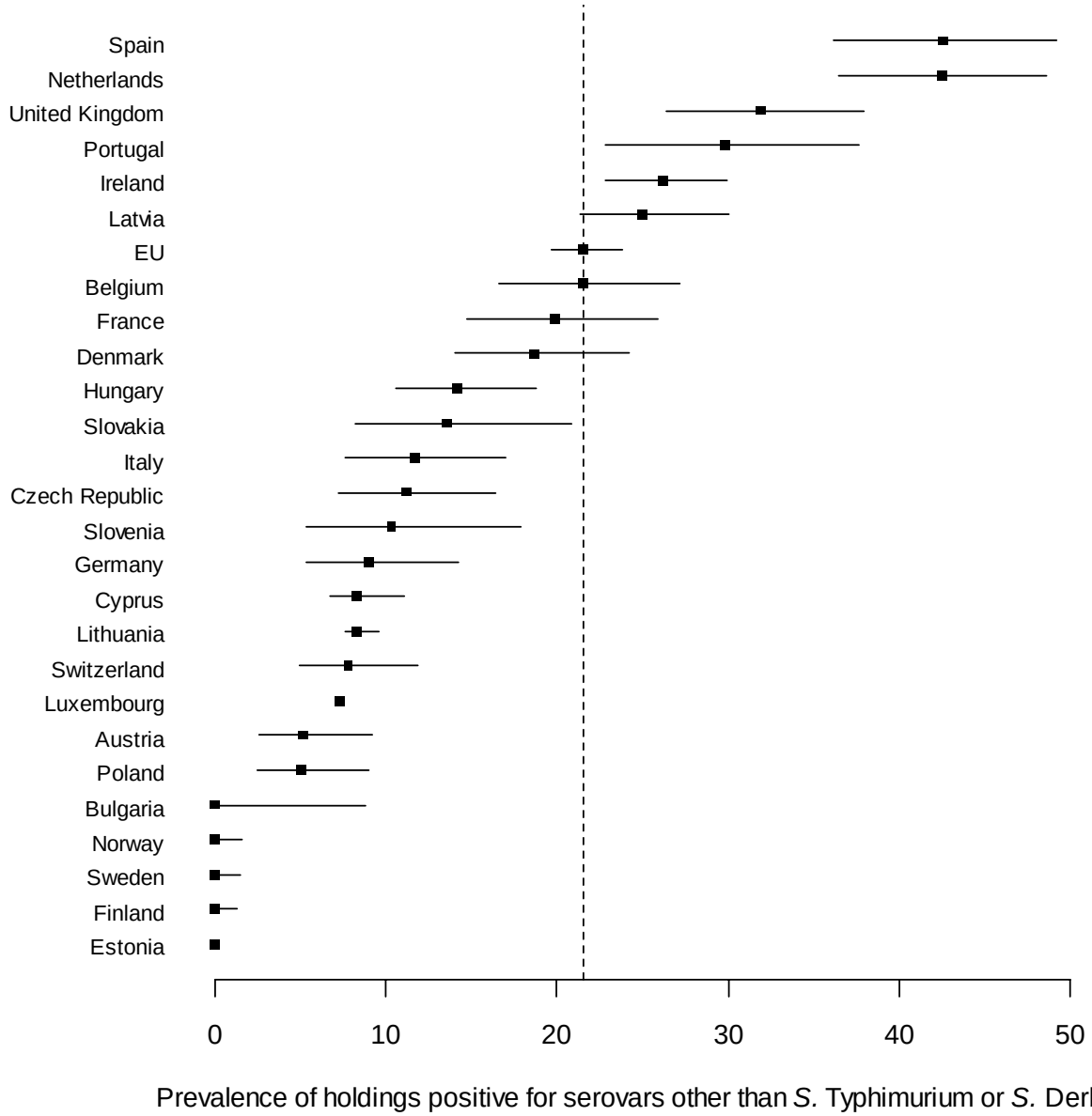

Figure 28 Prevalence[(a)] of production holdings positive to serovars other than *Salmonella* Typhimurium or *Salmonella* Derby, with 95% CIs[(b)], *Salmonella* EU baseline survey, 2008[(c)]

(a): Horizontal bars represent 95% CIs. The EU prevalence is based on the holdings with at least 50 breeding pigs (see Material and Methods).

(b): As all existing breeding holdings are included in the survey in Estonia and Luxembourg (census sampling), a 95% CI based on a finite population approach cannot be calculated and therefore no CI is displayed, although the true CI is likely to be larger.

(c): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

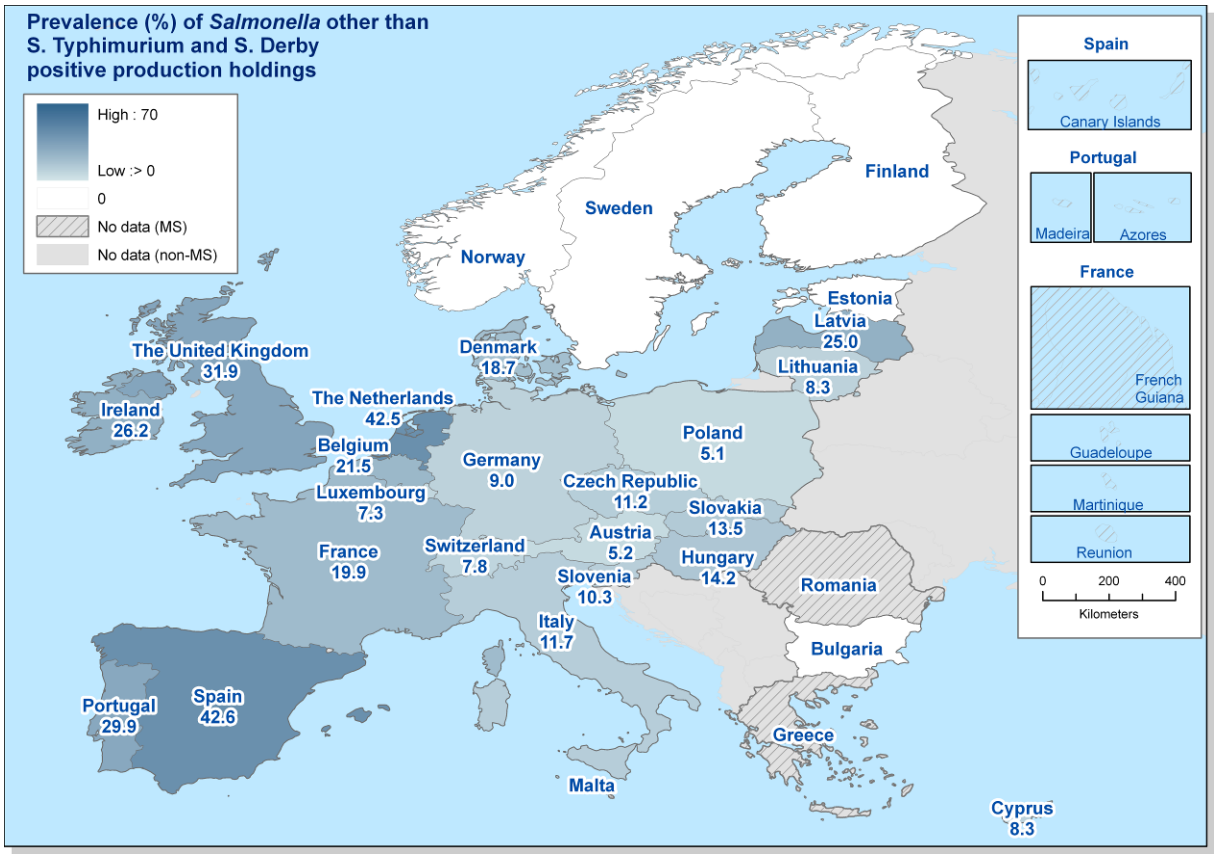

Figure 29 Prevalence of production holdings positive to serovars other than *Salmonella* Typhimurium or *Salmonella* Derby, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

I FREQUENCY DISTRIBUTION OF *SALMONELLA* SEROVARS IN BREEDING AND PRODUCTION HOLDINGS

Table 14 Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Austria	*S.* Typhimurium	6	50.0	3	60.0
	S. Derby	4	33.3	1	20.0
	S. Muenchen	2	16.7	1	20.0
	Total	12	100.0	5	
Belgium	*S.* Typhimurium	3	50.0	2	66.7
	S. Livingstone	2	33.3	1	33.3
	S. Derby	1	16.7	1	33.3
	Total	6	100.0	3	
Bulgaria	*S.* Virchow	1	100.0	1	100.0
	Total	1	100.0	1	
Cyprus	*S.* Derby	3	60.0	1	50.0
	S. Hadar	2	40.0	1	50.0
	Total	5	100.0	2	
Czech Republic	*S.* Typhimurium	9	24.3	4	36.4
	S. Bovismorbificans	12	32.4	2	18.2
	S. Agona	8	21.6	2	18.2
	S. Derby	5	13.5	1	9.1
	S. Brandenburg	2	5.4	1	9.1
	S. Concord	1	2.7	1	9.1
	Total	37	100.0	11	
Denmark	*S.* Typhimurium	30	21.4	15	38.5
	S. Derby	52	37.1	12	30.8
	S. Livingstone	23	16.4	8	20.5
	S. Infantis	19	13.6	6	15.4
	S. Muenchen	9	6.4	2	5.1
	S. Uganda	2	1.4	1	2.6
	S. Kedougou	1	0.7	1	2.6
	S. Panama	1	0.7	1	2.6
	S. Rissen	1	0.7	1	2.6
	Salmonella untypeable	2	1.4	2	5.1
	Total	140	100.0	39	

Table 14 (contd.): Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
France	*S.* Derby	78	43.3	40	50.6
	S. Infantis	30	16.7	19	24.1
	S. Typhimurium	23	12.8	11	13.9
	S. Kedougou	10	5.6	5	6.3
	S. Anatum	5	2.8	3	3.8
	S. London	10	5.6	2	2.5
	S. Livingstone	5	2.8	2	2.5
	S. Agona	2	1.1	2	2.5
	S. Panama	2	1.1	2	2.5
	S. Bredeney	2	1.1	1	1.3
	S. Give	2	1.1	1	1.3
	S. Coeln	1	0.6	1	1.3
	S. Cubana	1	0.6	1	1.3
	S. Lindenburg	1	0.6	1	1.3
	S. Mbandaka	1	0.6	1	1.3
	S. Muenchen	1	0.6	1	1.3
	S. Rissen	1	0.6	1	1.3
	S. Rubislaw	1	0.6	1	1.3
	S. Senftenberg	1	0.6	1	1.3
	S. Virchow	1	0.6	1	1.3
	S. Worthington	1	0.6	1	1.3
	Salmonella untypeable	1	0.6	1	1.3
	Total	180	100.0	79	
Germany	*S.* Derby	13	37.1	5	38.5
	S. Typhimurium	12	34.3	4	30.8
	S. Livingstone	4	11.4	2	15.4
	S. Thompson	2	5.7	1	7.7
	S. 4,12:i:-	1	2.9	1	7.7
	S. Bovismorbificans	1	2.9	1	7.7
	Salmonella untypeable	2	5.7	2	15.4
	Total	35	100.0	13	

Table 14 (contd.): Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Hungary	*S.* Typhimurium	7	25.9	4	33.3
	S. Derby	4	14.8	3	25.0
	S. London	4	14.8	2	16.7
	S. Infantis	2	7.4	2	16.7
	S. Agona	2	7.4	1	8.3
	S. Bredeney	2	7.4	1	8.3
	S. Hadar	2	7.4	1	8.3
	S. Saintpaul	2	7.4	1	8.3
	S. Bovismorbificans	1	3.7	1	8.3
	S. Enteritidis	1	3.7	1	8.3
	Total	27	100.0	12	
Ireland	*S.* Derby	19	29.7	8	38.1
	S. Typhimurium	21	32.8	7	33.3
	S. Bredeney	10	15.6	3	14.3
	S. Livingstone	5	7.8	2	9.5
	S. Infantis	4	6.3	1	4.8
	S. Altona	2	3.1	1	4.8
	S. Virchow	2	3.1	1	4.8
	Salmonella untypeable	1	1.6	1	4.8
	Total	64	100.0	21	
Italy	*S.* Derby	12	19.4	7	31.8
	S. Typhimurium	4	6.5	3	13.6
	S. Manhattan	5	8.1	2	9.1
	S. Livingstone	4	6.5	1	4.5
	S. Anatum	3	4.8	1	4.5
	S. Braenderup	2	3.2	1	4.5
	S. Infantis	1	1.6	1	4.5
	S. London	1	1.6	1	4.5
	S. Ohio	1	1.6	1	4.5
	Salmonella untypeable	29	46.8	14	63.6
	Total	62	100.0	22	
Latvia	*S.* Derby	2	66.7	1	100.0
	S. Bredeney	1	33.3	1	100.0
	Total	3	100.0	1	
Luxembourg	*S.* Infantis	2	100.0	1	100.0
	Total	2	100.0	1	

Table 14 (contd.): Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Netherlands	*S.* Derby	45	22.1	20	31.7
	S. Typhimurium	32	15.7	15	23.8
	S. London	42	20.6	12	19.0
	S. Goldcoast	17	8.3	6	9.5
	S. Livingstone	18	8.8	5	7.9
	S. Infantis	7	3.4	5	7.9
	S. 4,5,12:d:-	17	8.3	4	6.3
	S. 9,12:l,v:-	6	2.9	3	4.8
	S. Anatum	2	1.0	2	3.2
	S. Brandenburg	2	1.0	2	3.2
	S. Agona	5	2.5	1	1.6
	S. 4,5,12:i:-	2	1.0	1	1.6
	S. Falkensee	2	1.0	1	1.6
	S. Heidelberg	2	1.0	1	1.6
	S. Panama	2	1.0	1	1.6
	S. Ohio	1	0.5	1	1.6
	S. Worthington	1	0.5	1	1.6
	Salmonella untypeable	1	0.5	1	1.6
	Total	204	100.0	63	100.0
Poland	*S.* Typhimurium	15	62.5	4	40.0
	S. Enteritidis	5	20.8	3	30.0
	S. Derby	2	8.3	2	20.0
	S. Agona	1	4.2	1	10.0
	S. Senftenberg	1	4.2	1	10.0
	Total	24	100.0	10	
Portugal	*S.* Rissen	8	21.1	6	40.0
	S. London	7	18.4	3	20.0
	S. Derby	6	15.8	3	20.0
	S. Typhimurium	6	15.8	3	20.0
	S. Give	5	13.2	2	13.3
	S. 4,5,12:i:-	2	5.3	2	13.3
	S. 1,3,19:-:-	1	2.6	1	6.7
	S. Livingstone	1	2.6	1	6.7
	S. Mbandaka	1	2.6	1	6.7
	S. Muenchen	1	2.6	1	6.7
	Total	38	100.0	15	

Table 14 (contd.): Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Slovakia	S. Derby	7	30.4	3	27.3
	S. Typhimurium	3	13.0	2	18.2
	S. Enteritidis	5	21.7	1	9.1
	S. London	3	13.0	1	9.1
	S. 6,7:-:1,5	2	8.7	1	9.1
	S. Agona	1	4.3	1	9.1
	S. Ohio	1	4.3	1	9.1
	S. Worthington	1	4.3	1	9.1
	Total	23	100.0	11	
Spain	S. Rissen	46	15.6	24	25.0
	S. Typhimurium	34	11.6	21	21.9
	S. Anatum	37	12.6	18	18.8
	S. Derby	31	10.5	15	15.6
	S. Muenchen	16	5.4	8	8.3
	S. Wien	11	3.7	8	8.3
	S. Meleagridis	17	5.8	7	7.3
	S. London	15	5.1	7	7.3
	S. Reading	20	6.8	6	6.3
	S. Bredeney	11	3.7	6	6.3
	S. Kapemba	7	2.4	4	4.2
	S. Goldcoast	6	2.0	4	4.2
	S. Brandenburg	5	1.7	4	4.2
	S. Bovismorbificans	9	3.1	3	3.1
	S. Brikama	9	3.1	3	3.1
	S. Enteritidis	4	1.4	3	3.1
	S. 4,12:i:-	2	0.7	2	2.1
	S. 4,5,12:i:-	2	0.7	2	2.1
	S. Amsterdam	2	0.7	1	1.0
	S. Livingstone	2	0.7	1	1.0
	S. Mishmarhaemek	2	0.7	1	1.0
	S. Agona	1	0.3	1	1.0
	S. Altona	1	0.3	1	1.0
	S. Cerro	1	0.3	1	1.0
	S. IIIb 42:l,v:z	1	0.3	1	1.0
	S. Kedougou	1	0.3	1	1.0
	S. Tennessee	1	0.3	1	1.0
	Total	294	100.0	96	
Sweden	S. Typhimurium	1	100.0	1	100.0
	Total	1	100.0	1	

Table 14 (contd.): Frequency distribution of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Switzerland	S. Typhimurium	3	10.7	3	27.3
	S. Amsterdam	12	42.9	2	18.2
	S. Ohio	4	14.3	1	9.1
	S. Livingstone	3	10.7	1	9.1
	S. Brandenburg	2	7.1	1	9.1
	S. Derby	2	7.1	1	9.1
	S. Muenchen	1	3.6	1	9.1
	S. 4,12:i:-	1	3.6	1	9.1
	Total	28	100.0	11	
United Kingdom	S. Typhimurium	24	20.5	13	37.1
	S. Derby	26	22.2	10	28.6
	S. Kedougou	14	12.0	8	22.9
	S. Panama	11	9.4	4	11.4
	S. Goldcoast	6	5.1	3	8.6
	S. Reading	5	4.3	2	5.7
	S. Bovismorbificans	2	1.7	2	5.7
	S. 4,5,12:i:-	7	6.0	1	2.9
	S. Orion	5	4.3	1	2.9
	S. Livingstone	4	3.4	1	2.9
	S. Mbandaka	3	2.6	1	2.9
	S. Rissen	3	2.6	1	2.9
	S. Anatum	2	1.7	1	2.9
	S. 9,12:l,v:-	1	0.9	1	2.9
	S. Bredeney	1	0.9	1	2.9
	S. Give	1	0.9	1	2.9
	S. London	1	0.9	1	2.9
	S. Newport	1	0.9	1	2.9
	Total	117	100.0	35	

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

(b): Proportion (%) of each specific *Salmonella* serovar out of the total isolates.

(c): Proportion (%) of holdings positive for each specific *Salmonella* serovar out of the total *Salmonella*-positive holdings.

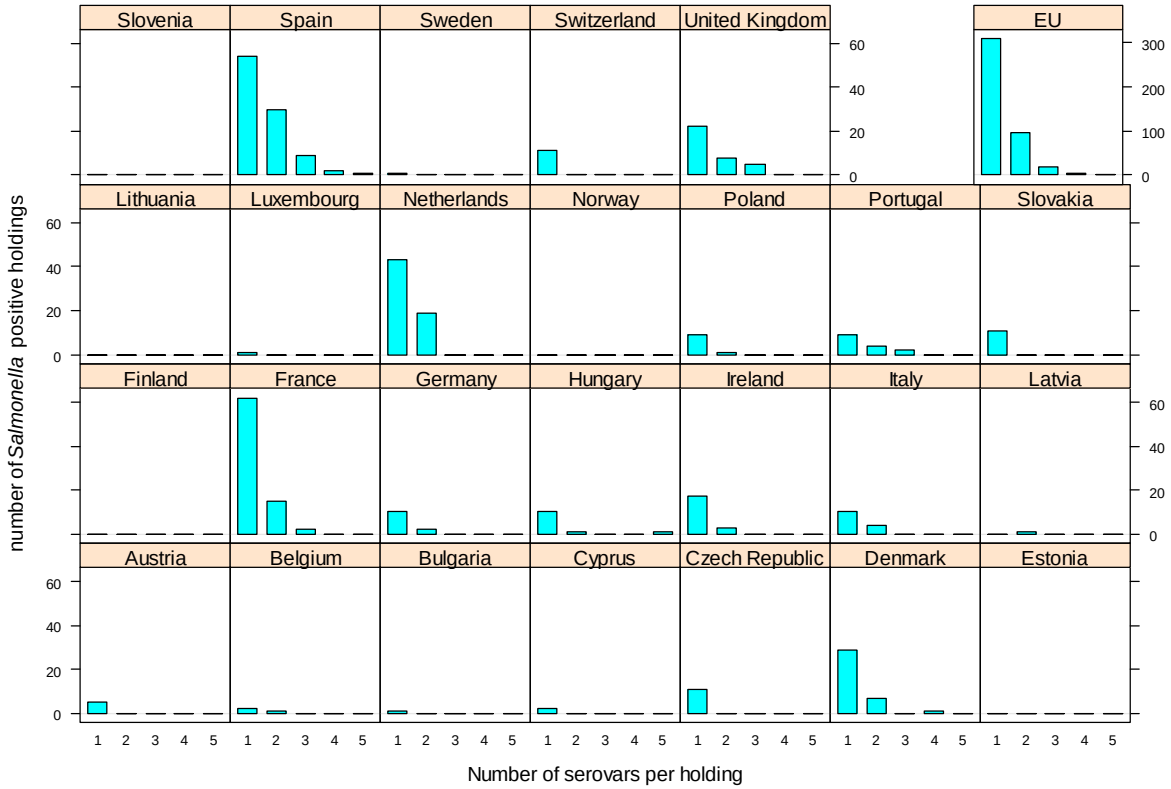

Figure 30 Distribution of number of *Salmonella* serovars in breeding holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

Table 15 Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Austria	*S.* Livingstone	6	30.0	2	20.0
	S. Indiana	4	20.0	2	20.0
	S. Montevideo	2	10.0	2	20.0
	S. Derby	5	25.0	1	10.0
	S. Bredeney	1	5.0	1	10.0
	S. Mbandaka	1	5.0	1	10.0
	S. Tennessee	1	5.0	1	10.0
	Total	20	100.0	10	
Belgium	*S.* Typhimurium	40	19.1	23	30.3
	S. Derby	69	33.0	21	27.6
	S. Livingstone	12	5.7	10	13.2
	S. Rissen	7	3.3	6	7.9
	S. Anatum	8	3.8	5	6.6
	S. Brandenburg	7	3.3	4	5.3
	S. Infantis	7	3.3	4	5.3
	S. Goldcoast	5	2.4	4	5.3
	S. London	3	1.4	3	3.9
	S. Panama	8	3.8	2	2.6
	S. Virchow	6	2.9	2	2.6
	S. 3,10:l,v:-	5	2.4	2	2.6
	S. Llandoff	2	1.0	2	2.6
	S. Wien	5	2.4	1	1.3
	S. Bredeney	4	1.9	1	1.3
	S. Bovismorbificans	3	1.4	1	1.3
	S. 3,10:-:-	2	1.0	1	1.3
	S. Cannstatt	2	1.0	1	1.3
	S. Manhattan	2	1.0	1	1.3
	S. 6,7:r:-	1	0.5	1	1.3
	S. 6,8:-:-	1	0.5	1	1.3
	S. Eko	1	0.5	1	1.3
	S. Enteritidis	1	0.5	1	1.3
	S. Give	1	0.5	1	1.3
	S. Ohio	1	0.5	1	1.3
	S. Worthington	1	0.5	1	1.3
	Salmonella untypeable	5	2.4	5	6.6
	Total	209	100.0	76	
Cyprus	*S.* Derby	11	47.8	5	45.5
	S. Bredeney	4	17.4	3	27.3
	S. Newport	3	13.0	1	9.1
	S. London	2	8.7	1	9.1
	S. Loanda	1	4.3	1	9.1
	Salmonella untypeable	2	8.7	1	9.1
	Total	23	100.0	11	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Czech Republic	*S.* Agona	42	47.2	13	52.0
	S. Derby	13	14.6	6	24.0
	S. Typhimurium	9	10.1	4	16.0
	S. Enteritidis	11	12.4	2	8.0
	S. Ohio	7	7.9	1	4.0
	S. Infantis	3	3.4	1	4.0
	S. London	2	2.2	1	4.0
	S. 4,12:i:-	1	1.1	1	4.0
	S. Dresden	1	1.1	1	4.0
	Total	89	100.0	25	
Denmark	*S.* Derby	93	37.3	29	35.4
	S. Typhimurium	52	20.9	25	30.5
	S. Infantis	43	17.3	18	22.0
	S. Livingstone	15	6.0	7	8.5
	S. London	13	5.2	3	3.7
	S. Agona	8	3.2	3	3.7
	S. Enteritidis	2	0.8	2	2.4
	S. Meleagridis	6	2.4	1	1.2
	S. Mbandaka	5	2.0	1	1.2
	S. Panama	4	1.6	1	1.2
	S. Rissen	3	1.2	1	1.2
	S. Newport	2	0.8	1	1.2
	S. Idikan	1	0.4	1	1.2
	S. London var. 15	1	0.4	1	1.2
	Salmonella untypeable	1	0.4	1	1.2
	Total	249	100.0	82	
Estonia	*S.* 4,5,12:i:-	2	66.7	1	100.0
	Salmonella untypeable	1	33.3	1	100.0
	Total	3	100.0	1	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
France	*S.* Derby	79	42.0	38	52.8
	S. Infantis	19	10.1	10	13.9
	S. Typhimurium	9	4.8	6	8.3
	S. Livingstone	7	3.7	4	5.6
	S. Bredeney	9	4.8	3	4.2
	S. Agona	3	1.6	3	4.2
	S. London	11	5.9	2	2.8
	S. Anatum	7	3.7	2	2.8
	S. Goldcoast	6	3.2	2	2.8
	S. Panama	4	2.1	2	2.8
	S. Mbandaka	3	1.6	2	2.8
	S. Muenster	2	1.1	2	2.8
	S. Meleagridis	5	2.7	1	1.4
	S. Bovismorbificans	4	2.1	1	1.4
	S. Kedougou	4	2.1	1	1.4
	S. 41:r:-	3	1.6	1	1.4
	S. Brandenburg	2	1.1	1	1.4
	S. Gaminara	2	1.1	1	1.4
	S. Give	2	1.1	1	1.4
	S. Dublin	1	0.5	1	1.4
	S. Montevideo	1	0.5	1	1.4
	S. Tennessee	1	0.5	1	1.4
	S. Virchow	1	0.5	1	1.4
	S. Westhampton	1	0.5	1	1.4
	Salmonella untypeable	2	1.1	1	1.4
	Total	188	100.0	72	
Germany	*S.* Derby	35	38.9	13	40.6
	S. Typhimurium	13	14.4	5	15.6
	S. Livingstone	5	5.6	3	9.4
	S. 4,5,12:i:-	3	3.3	2	6.3
	S. Bovismorbificans	3	3.3	2	6.3
	S. Goldcoast	7	7.8	1	3.1
	S. 9,12:l,v:-	6	6.7	1	3.1
	S. Anatum	5	5.6	1	3.1
	S. 4,12:i:-	4	4.4	1	3.1
	S. 4,12:l,v:-	3	3.3	1	3.1
	S. London	2	2.2	1	3.1
	S. Brandenburg	1	1.1	1	3.1
	S. Infantis	1	1.1	1	3.1
	S. Stourbridge	1	1.1	1	3.1
	S. Worthington	1	1.1	1	3.1
	Total	90	100.0	32	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Hungary	*S.* Derby	37	51.4	18	46.2
	S. Bovismorbificans	6	8.3	6	15.4
	S. Bredeney	4	5.6	4	10.3
	S. Give	4	5.6	2	5.1
	S. London	4	5.6	2	5.1
	S. Livingstone	3	4.2	2	5.1
	S. Typhimurium	2	2.8	2	5.1
	S. Senftenberg	3	4.2	1	2.6
	S. Anatum	2	2.8	1	2.6
	S. Stanley	2	2.8	1	2.6
	S. Infantis	1	1.4	1	2.6
	S. Lille	1	1.4	1	2.6
	S. Montevideo	1	1.4	1	2.6
	S. Muenster	1	1.4	1	2.6
	Salmonella untypeable	1	1.4	1	2.6
	Total	72	100.0	39	
Ireland	*S.* Typhimurium	62	32.3	26	36.6
	S. Derby	45	23.4	20	28.2
	S. Infantis	27	14.1	12	16.9
	S. Bredeney	13	6.8	9	12.7
	S. London	7	3.6	4	5.6
	S. Give	6	3.1	4	5.6
	S. Kentucky	7	3.6	3	4.2
	S. Livingstone	4	2.1	3	4.2
	S. Altona	3	1.6	2	2.8
	S. Manhattan	5	2.6	1	1.4
	S. Anatum	2	1.0	1	1.4
	S. Muenster	2	1.0	1	1.4
	S. Wien	2	1.0	1	1.4
	S. Brandenburg	1	0.5	1	1.4
	S. Goldcoast	1	0.5	1	1.4
	S. Mbandaka	1	0.5	1	1.4
	S. Putten	1	0.5	1	1.4
	S. Saintpaul	1	0.5	1	1.4
	S. Virchow	1	0.5	1	1.4
	Salmonella untypeable	1	0.5	1	1.4
	Total	192	100.0	71	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Italy	*S.* Derby	47	22.1	21	28.0
	S. Typhimurium	13	6.1	10	13.3
	S. London	32	15.0	7	9.3
	S. Anatum	16	7.5	7	9.3
	S. Bredeney	2	0.9	2	2.7
	S. Montevideo	4	1.9	1	1.3
	S. Braenderup	3	1.4	1	1.3
	S. Livingstone	2	0.9	1	1.3
	S. Infantis	1	0.5	1	1.3
	S. Thompson	1	0.5	1	1.3
	Salmonella untypeable	92	43.2	43	57.3
	Total	213	100.0	75	
Latvia	*S.* Kimuenza	10	43.5	2	25.0
	S. Bredeney	4	17.4	2	25.0
	S. Altona	3	13.0	1	12.5
	S. Derby	3	13.0	1	12.5
	S. London	2	8.7	1	12.5
	S. Agona	1	4.3	1	12.5
	Total	23	100.0	8	
Lithuania	*S.* 6,7:-:-	6	50.0	2	33.3
	S. Brandenburg	3	25.0	1	16.7
	S. Enteritidis	1	8.3	1	16.7
	S. Infantis	1	8.3	1	16.7
	S. London	1	8.3	1	16.7
	Total	12	100.0	6	
Luxembourg	*S.* Derby	13	68.4	7	77.8
	S. Typhimurium	3	15.8	1	11.1
	S. Dublin	1	5.3	1	11.1
	S. Infantis	1	5.3	1	11.1
	S. Livingstone	1	5.3	1	11.1
	Total	19	100.0	9	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Netherlands	*S.* Derby	78	19.8	36	30.5
	S. London	54	13.7	19	16.1
	S. Typhimurium	23	5.9	17	14.4
	S. Brandenburg	40	10.2	14	11.9
	S. Goldcoast	40	10.2	14	11.9
	S. Livingstone	27	6.9	14	11.9
	S. Anatum	19	4.8	7	5.9
	S. 4,5,12:i:-	10	2.5	7	5.9
	S. Bovismorbificans	16	4.1	6	5.1
	S. Infantis	14	3.6	4	3.4
	S. 9,12:l,v:-	5	1.3	3	2.5
	S. Panama	5	1.3	3	2.5
	S. Manhattan	8	2.0	2	1.7
	S. 4,5,12:d:-	6	1.5	2	1.7
	S. Give	5	1.3	2	1.7
	S. Heidelberg	5	1.3	2	1.7
	S. Kedougou	5	1.3	2	1.7
	S. Litchfield	5	1.3	2	1.7
	S. Stanley	4	1.0	2	1.7
	S. Cerro	5	1.3	1	0.8
	S. Goettingen	2	0.5	1	0.8
	S. Worthington	2	0.5	1	0.8
	S. 4,12:d:-	1	0.3	1	0.8
	S. Enteritidis	1	0.3	1	0.8
	S. Mbandaka	1	0.3	1	0.8
	S. Rissen	1	0.3	1	0.8
	Salmonella untypeable	11	2.8	7	5.9
	Total	393	100.0	118	
Poland	*S.* Derby	6	14.6	5	29.4
	S. Enteritidis	6	14.6	4	23.5
	S. Typhimurium	9	22.0	3	17.6
	S. Goldcoast	10	24.4	1	5.9
	S. Choleraesuis	3	7.3	1	5.9
	S. 4,12:b:-	2	4.9	1	5.9
	S. 4,12:i:-	2	4.9	1	5.9
	S. 4,5,12:i:-	1	2.4	1	5.9
	S. Abony	1	2.4	1	5.9
	S. Agona	1	2.4	1	5.9
	Total	41	100.0	17	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Portugal	*S.* Typhimurium	29	23.6	18	31.0
	S. Rissen	24	19.5	13	22.4
	S. London	17	13.8	9	15.5
	S. Derby	13	10.6	7	12.1
	S. 1,3,19:-:-	5	4.1	5	8.6
	S. Give	6	4.9	4	6.9
	S. Muenchen	4	3.3	3	5.2
	S. Brandenburg	8	6.5	2	3.4
	S. Bovismorbificans	4	3.3	2	3.4
	S. Gloucester	3	2.4	2	3.4
	S. Anatum	2	1.6	2	3.4
	S. 4,5,12:i:-	2	1.6	1	1.7
	S. Goldcoast	2	1.6	1	1.7
	S. 4,5,12:-:-	1	0.8	1	1.7
	S. Bredeney	1	0.8	1	1.7
	S. Mbandaka	1	0.8	1	1.7
	S. Senftenberg	1	0.8	1	1.7
	Total	123	100.0	58	
Slovakia	*S.* Enteritidis	10	25.6	4	22.2
	S. Derby	6	15.4	4	22.2
	S. Typhimurium	10	25.6	3	16.7
	S. Bovismorbificans	5	12.8	3	16.7
	S. Agona	3	7.7	2	11.1
	S. Bredeney	3	7.7	2	11.1
	S. Goldcoast	1	2.6	1	5.6
	S. Newport	1	2.6	1	5.6
	Total	39	100.0	18	
Slovenia	*S.* Enteritidis	7	26.9	3	33.3
	S. Infantis	8	30.8	2	22.2
	S. Coeln	6	23.1	2	22.2
	S. Stanleyville	2	7.7	1	11.1
	S. Agona	1	3.8	1	11.1
	S. Derby	1	3.8	1	11.1
	S. Virginia	1	3.8	1	11.1
	Total	26	100.0	9	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[(b)]	N	%[(c)]
Spain	*S.* Rissen	45	14.1	33	29.7
	S. Typhimurium	45	14.1	26	23.4
	S. Anatum	51	15.9	14	12.6
	S. Derby	24	7.5	14	12.6
	S. London	19	5.9	13	11.7
	S. Goldcoast	21	6.6	11	9.9
	S. Meleagridis	18	5.6	9	8.1
	S. Bredeney	14	4.4	8	7.2
	S. Muenchen	16	5.0	6	5.4
	S. Kapemba	8	2.5	5	4.5
	S. Reading	10	3.1	3	2.7
	S. Panama	9	2.8	3	2.7
	S. Wien	6	1.9	3	2.7
	S. Infantis	6	1.9	2	1.8
	S. Bovismorbificans	4	1.3	2	1.8
	S. 4,12:i:-	2	0.6	2	1.8
	S. Cerro	4	1.3	1	0.9
	S. 4,5,12:i:-	3	0.9	1	0.9
	S. Brikama	2	0.6	1	0.9
	S. Enteritidis	2	0.6	1	0.9
	S. II 13,23:g,t:-	2	0.6	1	0.9
	S. Tilburg	2	0.6	1	0.9
	S. 4,12:d:-	1	0.3	1	0.9
	S. Give	1	0.3	1	0.9
	S. Lille	1	0.3	1	0.9
	S. Livingstone	1	0.3	1	0.9
	S. Mbandaka	1	0.3	1	0.9
	S. Nottingham	1	0.3	1	0.9
	S. Ohio	1	0.3	1	0.9
	Total	320	100.0	111	
Switzerland	*S.* Bredeney	16	26.2	3	16.7
	S. Derby	14	23.0	3	16.7
	S. Typhimurium	12	19.7	3	16.7
	S. Brandenburg	4	6.6	2	11.1
	S. Enteritidis	4	6.6	2	11.1
	S. 4,12:d:-	4	6.6	1	5.6
	S. Ohio	2	3.3	1	5.6
	S. Tennessee	2	3.3	1	5.6
	S. Javiana	1	1.6	1	5.6
	S. Livingstone	1	1.6	1	5.6
	Salmonella untypeable	1	1.6	1	5.6
	Total	61	100.0	18	

Table 15 (contd.): Frequency distribution of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[a]

Country	*Salmonella* serovars			Holdings with isolates	
	Type	N	%[b]	N	%[c]
United Kingdom	*S.* London	60	20.4	23	27.4
	S. Derby	49	16.7	21	25.0
	S. Typhimurium	38	12.9	19	22.6
	S. Reading	28	9.5	15	17.9
	S. Kedougou	17	5.8	8	9.5
	S. Bovismorbificans	11	3.7	8	9.5
	S. Panama	9	3.1	5	6.0
	S. Goldcoast	15	5.1	3	3.6
	S. Anatum	5	1.7	3	3.6
	S. Give	4	1.4	3	3.6
	S. Stanley	3	1.0	3	3.6
	S. 4,5,12:i:-	4	1.4	2	2.4
	S. Newport	4	1.4	2	2.4
	S. Rissen	2	0.7	2	2.4
	S. Brandenburg	9	3.1	1	1.2
	S. Carno	8	2.7	1	1.2
	S. Kimuenza	5	1.7	1	1.2
	S. Livingstone	5	1.7	1	1.2
	S. Mishmarhaemek	4	1.4	1	1.2
	S. Kentucky	2	0.7	1	1.2
	S. 4,12:d:-	1	0.3	1	1.2
	S. 4,12:i:-	1	0.3	1	1.2
	S. Bredeney	1	0.3	1	1.2
	S. Hadar	1	0.3	1	1.2
	S. Litchfield	1	0.3	1	1.2
	S. Liverpool	1	0.3	1	1.2
	S. Mbandaka	1	0.3	1	1.2
	S. Miami	1	0.3	1	1.2
	S. Pakistan	1	0.3	1	1.2
	S. Senftenberg	1	0.3	1	1.2
	Salmonella untypeable	2	0.7	2	2.4
	Total	294	100.0	84	

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

(b): Proportion (%) of each specific *Salmonella* serovar out of the total isolates.

(c): Proportion (%) of holdings positive for each specific *Salmonella* serovar out of the total *Salmonella*-positive holdings.

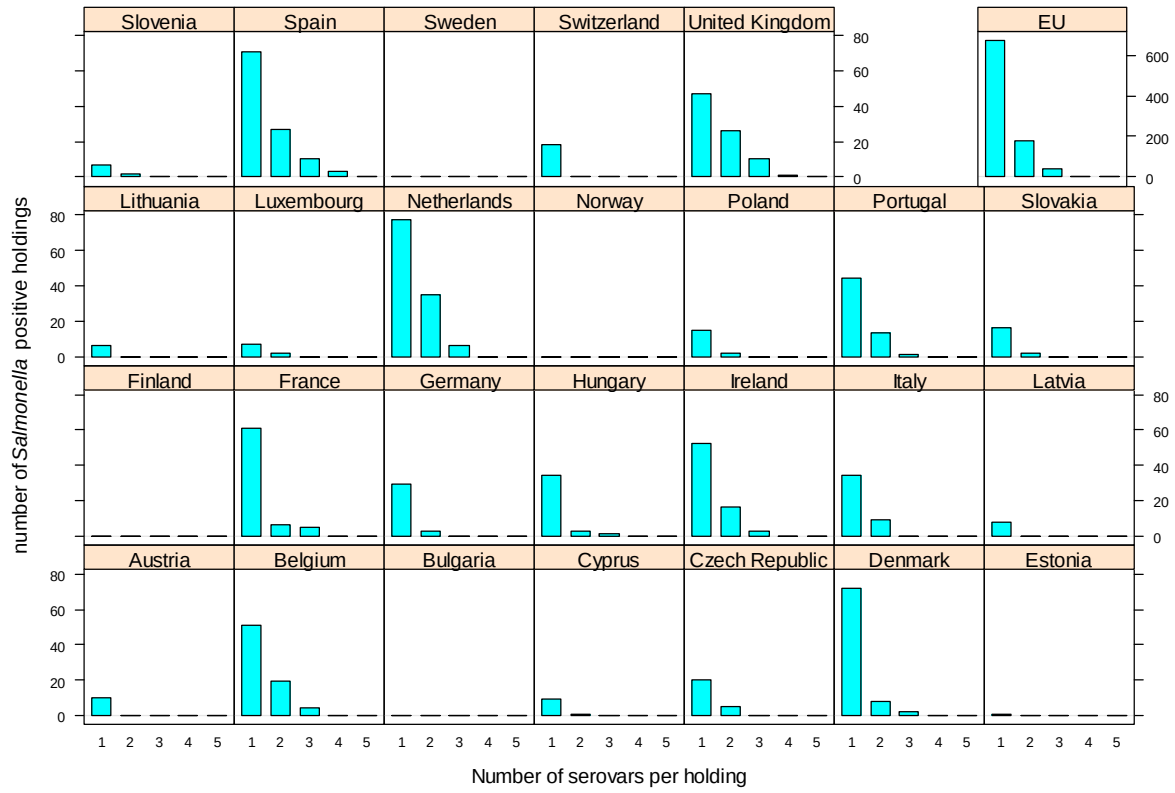

Figure 31 Distribution of number of *Salmonella* serovars in production holdings, *Salmonella* EU baseline survey, 2008[(a)]

(a): Greece, Malta and Romania did not conduct the survey and two non-MSs, Norway and Switzerland, participated.

GLOSSARY

Prevalence, apparent, observed and true	Observed prevalence, apparent prevalence or measured prevalence mean the prevalence estimated on the basis of a diagnostic test used to detect the infection in the given population. In contrast, true prevalence represents the actual prevalence of the infection in the population in question. True prevalence can be estimated from the apparent/observed prevalence by correcting for misclassification bias due to the imperfect diagnostic test used. The discrepancy between the apparent and the true prevalence is function of the sensitivity and the specificity of the diagnostic test used.
EU prevalence of positive pig holdings	An EU prevalence of positive pig holdings means the prevalence of positive pig holdings that is estimated on the basis of randomly selecting pig holdings across the EU for sampling and testing.
Boar	A male pig more than six months old and destined for use as a sire.
Breeding holding	Breeding holding means a holding having pigs retained for breeding purposes, covering both nucleus holdings and multiplier holdings. Breeding holdings produce and sell pigs mainly for breeding purposes. The nucleus holdings generate genetic improvement of pure-bred pigs to render them better adapted to the requirements of farmers, processors and consumers, and deliver future pure-bred breeding pigs to multiplier holdings. Multiplier holdings produce future hybrid breeding pigs and deliver them to the production farms with a breeding herd.
Breeding pig	Pig (sow or boar) of at least six months of age kept for breeding purposes
Dam	Female parent
Farrow	The act of parturition in the sow.
Farrow-to-finish holding	A pig holding consisting of a herd of sows and their piglets, which are born, reared, weaned, grown and fattened in the one holding.
Farrow-to-grower holding	A pig holding including a sow herd and its progeny in which piglets are born, reared, weaned and grown for several weeks and then moved to the care of specialist fatteners.
Farrow-to-weaner holding	A pig holding consisting of a herd of sows and their piglets, which are born and reared up to weaning in the one holding, and then moved to the care of specialist growers and fatteners.
Gilt	A gilt is a female breeding pig that has not yet had a litter of piglets.
Maiden gilt	A maiden gilt is a gilt which has not been in the service area yet.
Multiplier holding	Multiplier holding or supplier holding means a holding of pure-bred pigs that usually produce cross-bred future breeding pigs for production holdings.

Nucleus holding	Nucleus holding or pure-bred holding means a holding of pure-bred pigs that produces pure-bred breeding pigs (pure-bred gilts and boars) for multiplier and production holdings.
Production holding	Production holdings cover farrow-to-weaner holdings or farrow-to-grower holdings or farrow-to-finish holdings. Production holdings house breeding pigs and sell mainly pigs for fattening to other specialised holdings or for slaughter.
Sensitivity	Ability of a test to correctly detect individuals with the disease or infection of interest.
Sow	A female pig that has had a litter.
Specificity	Ability of a test to correctly detect individuals free of the disease or infection of interest.
Test misclassification bias	Quality of a test with erroneous classification reflecting its tendency to produce a consistent (directional) deviation from the true state.
Weaner	A young piglet being removed from the sow to switch from sow's milk to a dry feed.

ABBREVIATIONS

CI	Confidence Interval
CRL-*Salmonella*	Community Reference Laboratory for *Salmonella*
EC	European Commission
EFSA	European Food Safety Authority
EU	European Union
MS	Member State
NRL	National Reference Laboratory