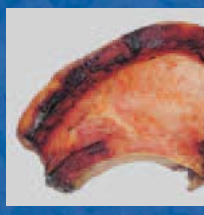
Surveillance and control programmes for terrestrial and aquatic animals in Norway

Annual report 2003







Editor
Tormod Mørk
Hege Hellberg
National Veterinary Institute

Responsible institutions:
National Veterinary Institute
Norwegian Food Safety Authority

Annual report 2003
Surveillance and control programmes for terrestrial and aquatic animals in Norway

Any use of the present data should include specific reference to this report.

ISSN 1503-1454

National Veterinary Institute
P.O.Box 8156 Dep.
N-0033 Oslo
Norway

Phone: + 47 23216000
Fax: + 47 23216095
E-mail: vipost@vetinst.no
Homepage: www.vetinst.no

Form: GRAF as

Printed by:

Oslo, July 2004

Contributors and participants

Editors:

Tormod Mørk National Veterinary Institute
Hege Hellberg National Veterinary Institute

The following institutions were responsible for the programmes:

Norwegian Animal Health Authority
Norwegian Food Control Authority

The following institutions were responsible for laboratory analyses and/or project management:

National Veterinary Institute
Norwegian Zoonosis Centre
Municipal Food Control Authorities
National Institute of Public Health
The Norwegian School of Veterinary Science
Aker University Hospital, Oslo
EELA National Veterinary and Food Research Institute, Helsinki
Plant Protection Center, Ås
Danish Veterinary Institute, Copenhagen

The following people are responsible for the administration of the programmes at the Veterinary Institute:

Tormod Mørk (terrestrial animals)
Hege Hellberg (aquatic animals)

A large number of samples have been collected by:

Norwegian Animal Health Authority, District Veterinary Officers
Farmers
Dairy and slaughterhouse employees
Municipal Food Control Authorities
County Environmental Departments

The major parts of the programmes were State funded. Additional financial support was provided by:

TINE Norwegian Dairies BA
GENO Breeding and AI Association Norway
Norwegian Meat Research Centre
Centre for Poultry Science
The poultry industry

The following people have been most helpful in revising the manuscripts:

Edgar Brun
Duncan Colquhoun
Helga Høgåsen
Peder Andreas Jansen
Jorun Tharaldsen

All maps are designed by Hanne Mari Jordsmyr, who also was responsible for creative initiative and contribution with reference to the design and layout of the report.

Contents:

Introduction

The spreading of diseases from one country to another through animals carrying pathogenic microorganisms is well recognized. Historically, there are numerous records of invading armies introducing diseases like rinderpest and bovine pleuropneumonia into conquered territories while diseases such as foot-and-mouth disease have been introduced to new countries and continents through trade. During the twentieth century, legislative measures with particular emphasis on border control became an important first line of defence against the movement of diseases into countries. A number of these diseases are zoonoses.

For many countries, strict border control has been an important measure in maintaining a favourable animal health situation. However, societal and political changes during the last decades have made this concept less reliable. Several factors contribute to the spread of pathogens to new areas and to ecosystems with susceptible animals, including an increasing human population and an increase in trade and wealth, which result in greater international movement of people, animals and animal products. An international legislative framework has been developed to regulate this. In Europe, a new political union with the concept of free movement of individuals and goods as an ideological basis has been established. Globally, the concept of international free trade has become expanded by new agreements. This political and economical progress represents a zoosanitary challenge for authorities responsible for the health of humans and animals.

The agreement on the European Economic Area (EEA) established 1 January 1994 and its revision of 1 January 1999, introduced new regulations for trade in animals and animal products in Norway. Import restrictions based on border control and quarantine were no longer permitted. The EU legislation with directives based on the concept of recognized freedom from a particular disease or additional guarantees made by the exporting country for animals or their products was an acceptable substitute for some diseases, while the protection provided against other diseases was reduced.

The agreement which established the World Trade Organisation (WTO) on 1 January 1995 has also removed barriers for international trade. The agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) introduced measures for protection of public, animal and plant health related to trade. The fundamental basis for the SPS Agreement is that trade regulations should be nondiscrimatory and based on scientific knowledge.

In response to the international agreements, Norway has adopted the EU directives and EU regulations with surveillance programmes as integrated components for some diseases. In addition national programmes were introduced for documentation and control of some diseases.

Surveillance programmes for documentation and control

Programmes according to EU-directives and regulations

The trade directives address several communicable diseases, which are controlled by restrictions on trade with infected herds and regions. Bovine tuberculosis and brucellosis were eradicated in Norway 40 to 50 years ago and a free-status was approved on historical data. In order to maintain the free-status a moderate surveillance programme was required in 2000. The status of enzootic bovine leukosis (EBL) has been documented and the few infected animals have been eliminated. On this basis, Norway will apply for free-status for enzootic bovine leukosis. In poultry, programmes for Newcastle disease, *Mycoplasma* and *Salmonella* were established according to EU-directives. Surveillance of bovine spongiform encephalopathy (BSE) in cattle and scrapie in sheep and goats is performed according to the requirements of the EU regulations. A comparable programme is the testing for residues of drugs and toxic substances in live animals and animal products of ruminants, pigs and poultry.

The programmes for aquatic animals are of increasing importance due to an expanding aquaculture industry. Their purpose is twofold, combining prevention of introduction of the diseases through import from infected premises or regions, and the documentation of a free-status to benefit the export of aquaculture products. The surveillance for viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN) was initially based on the recognition of free-status for these diseases on historical data. The programmes for bonamiosis and marteiliosis in shellfish are the basis for free-status applications for these parasite infections.

Programmes approved by EU

Some diseases are not regulated by common EU rules. However, countries may apply for additional guarantees based on their documented status. In 1994, additional guarantees for infectious bovine rhinotracheitis (IBR) in cattle and Aujezsky's disease (AD) in pigs were granted.

During the negotiations for membership in 1994, the favourable *Salmonella* situation in Norway, Sweden and Finland was recognized by the EU. The additional guarantees were based on national surveillance and control programmes for cattle, pigs and poultry.

National surveillance and control programmes

Several diseases of great national significance have no legal basis in the EU legislation. Norwegian authorities and industries have for years used great efforts and resources to control and eradicate diseases such as bovine virus diarrhoea (BVD) in cattle, and scrapie and maedi in small ruminants.

Ongoing programmes for terrestrial and aquatic animals in 2003 (the year of initiation in parentheses)

Animal category	Programmes according to EU-directives and regulations	Programmes approved by EU	National surveillance and control programmes
Cattle	BSE (1998) Residual substances (1999) EBL (1994) Tuberculosis (2000) Brucellosis (2000)	IBR/IPV (1992) *Salmonella* (1995)	Paratuberculosis (1996) BVD (1992) STEC (1998)
Swine	Residual substances (1999)	AD (1994) *Salmonella* (1995)	TGE (1995) PRRS (1995) Swine influenza (1997)
Small ruminants	Scrapie (1997)		Maedi (1997)
Poultry	Residual substances (1999) Newcastle disease Mycoplasma *Salmonella* (1995-breeding flocks)	*Salmonella* (1995-96)	ILT (1997) ART (1997) *Campylobacter* (2001)
Farmed deer	Tuberculosis (2000)		
Llama			Paratuberculosis (2000)
Fish	VHS/IHN (1994)		*Pasteurella piscicida* (1999) VNN (1999) *Anguillicola* (1999) *Gyrodactylus salaris* (2000)
Shellfish	*Bonamia/marteilia* (1995)		

BSE=bovine spongiform encephalopathy, EBL=enzootic bovine leukosis, IBR=infectious bovine rhinotracheitis, IPV=infectious pustular vulvovaginitis, BVD=bovine virus diarrhoea, STEC=Shigatoxin-producing *E. coli*, AD=Aujeszky's disease, TGE=transmissible gastroenteritis, PRRS=porcine reproductive and respiratory syndrome, ILT=infectious laryngotracheitis, ART=avian rhinotracheitis, VHS=viral haemorrhagic septicaemia, IHN=infectious haematopoietic necrosis, VNN=viral nervous necrosis.

Responsibilities for the programmes

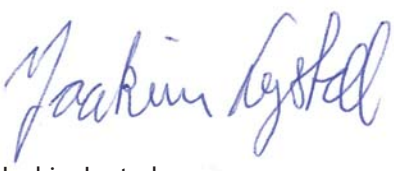
The surveillance and control programmes are included in the legislation for terrestrial and aquatic animal health and food in Norway, as decided by the Ministry of Agriculture and Ministry of Fisheries. The Norwegian Food Safety Authority is responsible for all measures related to this legislation. The National Veterinary Institute ensures the scientific quality of the programmes with regard to epidemiological design, by testing and analysing with approved methods and by presenting, interpreting and reporting the results according to accepted standards.

The economic funding for the programmes in 2003 was provided by the Ministry of Agriculture with some contribution from the industries. Sampling is performed by or under the supervision of veterinary officers.

Impact of the programmes

The programmes serve several purposes for Norwegian authorities and for the agriculture and aquaculture industries. Norway complies with legal commitments in relation to EU directives and rules. The programmes have contributed to decreasing the risk associated with trade of animals and animal products. Contagious diseases with great economic significance for the Norwegian livestock population have also been diagnosed through the programmes, enabling both their prompt eradication and the rapid introduction of preventive measures to counter further exposure.

Furthermore, several of the diseases included are zoonotic diseases and consequently the programmes constitute a scientific documentation with great significance for food safety. Finally, the documentation provided is important for industries exporting animals, breeding material and products originating from Norwegian terrestrial and aquatic animals.



Joakim Lystad

Managing Director,
Norwegian Food Safety Authority

Roar Gudding

Managing Director,
National Veterinary Institute

Main results from the surveillance and control programmes in 2003

Antibodies against avian rhinotrachitis (ART) were for the first time detected in a Norwegian commercial poultry farm.

The serologically based surveillance programme for maedi-visna, has been performed in the counties of Rogaland and Hordaland since 1997. In December 2002 maedi-visna was diagnosed in a ewe in Verdal, slaughtered because of respiratory symptoms. Serological investigation of the flock from which the ewe originated, revealed around 60% of the animals sampled to be seropositive for maedi-visna virus. The investigated flock was a central breeding flock in Nord-Trøndelag, and follow-up investigations of «contact flocks» revealed approximately 45 flocks with seropositive animals. The spread of maedi-visna virus precipitated the authorities into instigation of a countrywide surveillance programme for maedi-visna. According to the programme, all sheep breeding flocks will be subjected to serological testing in the course of a 2-year period. Seropositive animals were identified in one of 452 breeding flocks analysed during 2003.

As a result of changes in EU regulations the surveillance programme for scrapie in sheep and goats was significantly extended during 2003. In 2002 13,552 slaughtered animals were investigated with three positive finds. In 2003, 35,134 slaughtered animals were investigated with five positive finds. A far as fallen stock are concerned, 1,822 and 3,588 sheep and goats were investigated during 2002 and 2003 respectively. Three positive animals were identified during 2002 and eight during 2003. With the exception of one case of classical scrapie in 2002, followed by one classic case identified in 2003 as a result of follow up investigations, all cases in 2002 (8) and 2003 (14) were caused by the new type of scrapie known as Nor98. The results from the two last years indicate that the frequency of Nor98 type scrapie is significantly higher in the group of fallen stock than in the slaughtered group.

At the turn of the year 2003/2004 only three cattle flocks were subject to restrictions on account of BVD. Thanks to good cooperation between the National Veterinary Institute, the authorities and industry over a period of more than 10 years, it appears that extermination of this virus from the cattle population may be possible within a relatively short time.

The Salmonella situation within the domestic animal population remains very good. In 2003, Salmonella was identified in two samples from cattle and swine respectively and one sample from slaughtered chicken.

In 2003 the paratuberculosis bacterium was found in a new cattle flock and in three new goat flocks.

The health situation is also good as far as important diseases of fish and shellfish are concerned. Gyrodactylus salaris was detected in one new river in 2003.

Otherwise, no A- or B-diseases have been detected in the surveillance and control programmes for cattle, small ruminants, poultry, fish and oysters (see oversight).

**Samples analysed in the laboratories of the Norwegian Food Authority.*

Species	*Infection*	Start	Extent of programmes
Cattle	IBR/IPV	1992	10% of dairy cattle her 10% of beef cattle herd
	Brucellosis	2000	20% of dairy cattle her 20% of beef cattle herd
		2000	In cases of abortion
	BVD	1992	All herds
	EBL	1994	10% of dairy cattle her 10% of beef cattle herd
	Tuberculosis	2000	Inspection of carcasses suspected lesions for t
	BSE	1998	Investigation of clinica
		2000	Testing of imported an
		2001	Testing of fallen stock animals
		2001 2001	Testing of animals sele Testing of randomly se
	EHEC	1998	150 selected dairy catt
Swine	AD	1994	All breeding herds and fattening herds are tes
	TGE	1994	«
	PRRS	1995	«
	Swine influenza	1997	«
Poultry	Newcastle disease		All chicken and turkey
	ILT	1997	All chicken breeder flo
	ART	1997	All chicken and turkey
Small ruminants	Scrapie	1997	Testing of clinically sus
		2002	Testing of fallen stock
		1997	Random sampling of sla
			Testing of primary and
	Maedi	1997	Approximately 15% of f Hordaland and Rogalan All breeding flocks dur
Several species	Salmonellosis	1995	Cattle: 3,000 lymph no Swine: 3,000 lymph no from all breeding herds Poultry: faecal samples ers or >250 layers/bree
	Paratuberculosis	1996	Testing of clinically sus Testing of all llamas an goat and sheep herds
Fish	VHS/IHN	1994	Sampling of approxima turbot farms (all farms two-year period)
	Gyrodactylus salaris	2000	Sampling of approxima salmon and rainbow tr lantic salmon fingerling mately 130 rivers
	VNN	1999	All hatcheries producin
	Anguillicola	1999	All eel farms
Oyster	Bonamiosis	1995	All farms are inspected
	Marteiliosis	1995	«

s in 2003	Number of samples examined in 2003	Positive samples in 2003	Earlier positive results
ds ds	1,845 bulk milk samples 3,901 blood samples from 449 herds	None	1992: 1 positive herd
ds ds	3,684 bulk milk samples 7,905 blood samples from 887 herds	None	
	Foetuses from 34 cows from 28 herds	None	
	17,549 bulk milk samples 2,100 pooled blood samples	1998: restrictions lifted in 483 cases and imposed in 138, 1999: restrictions lifted in 267 cases and imposed in 114, 2000: restrictions lifted in 136 cases and imposed in 84, 2001: restrictions lifted in 96 cases and imposed in 64, 2002: restrictions lifted in 103 cases and imposed in 12, 2003: restrictions lifted in 12 cases and imposed in 1 herd.	
ds ds	1,845 bulk milk samples 3,901 blood samples from 449 herds	None	1995: 8 positive herds 1996: 1 positive herd 2002: 1 positive herd
s at slaughter, submission of esting	Organs from 2 individuals	None	1984: 1 positive herd 1986: 1 positive herd
lly suspect animals	2 samples	None	None
imals and their progeny	39 samples	None	None
and emergency slaughtered	9,194 samples	None	None
cted at *ante mortem* control lected slaughtered animals	4,102 samples 10,726 samples	None	None
tle herds	1,221 samples from 137 herds	1 positive herd	1998: 1 positive herd
a selection of integrated and sted	4,764 samples from 482 herds	None	None
	4,764 samples from 482 herds	None	None
	4,764 samples from 482 herds	None	None
	4,764 samples from 482 herds	None	1998: 1 positive herd (H3N2)
breeder flocks	5,854 samples from 76 farms	None	None
ocks	3,060 samples from 72 farms	None	None
breeder flocks	3,210 samples from 76 farms	1 positive flock	None
spect animals	17 samples	1 positive individual	1997: 5 positive samples, 1998: 3 positive, 1999: 3 positive, 2000: 5 positive, 2001: 1 positive, 2002: 3 positive
	3,576 samples	8 positive	2002: 3 positive samples
aughtered animals	35,128 samples	5 positive	2001: 1 positive sample, 2002: 3 positive
secondary herds	1,072 samples	1 positive	
flocks in the counties of nd. ing the period 2003-2005	19,629 samples from 842 flocks	1 positive flock	1998: 1 positive, 1999: 1 positive
ode samples de samples, faecal samples s s from all flocks of >50 broil-eders	2,554 lymph node samples* 2,996 lymph node samples* 2,377 faecal samples from 154 herds 6,899 faecal samples from 1,454 flocks	5 positive (2 cattle, 2 swine and 1 broiler)	1995-2000: Only a few positive samples yearly 2001: 2 positive (1 cattle and 1 breeding flock of parent birds for broiler production) 2002: 5 positive (1 cattle and 4 swine)
spect animals nd randomly selected cattle,	Organ and faecal samples from 1,092 cattle, 689 goats, 554 sheep and 54 llamas	3 goat herds	1997: 4 cattle herds (imports), 1998: 1 cattle herd, 2001: 2 cattle and 5 goat herds, 2002: 2 cattle, 2 sheep and 5 goat herds
tely half of all salmonid and s are tested in the course of a	15,150 samples from 498 sites	None	None
tely half of all fresh water out farms. Sampling of At-gs/parr/smolts from approxi-	2,598 fish from 86 salmonid farms 4,489 fish from 126 rivers	No salmonid farms 1 positive river	39 positive salmonid farms (1975-2002) 44 positive rivers (1975-2002)
ng halibut, turbot and cod	690 fish from 20 hatcheries	None	1995-1998: 2-5 hatcheries (clinical cases only) 1999: 2 hatcheries, 2001: 1 hatchery, 2002: 1 hatchery
	30 eels from one farm	None	1993-1999: 1 farm
d twice annually	480 oysters from 8 sample points	None	None
	«	«	«

The livestock and aquaculture populations in Norway

Annual report 2003

Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

The livestock population

Norway covers an area of 323,895 square km and has a population of about 4.7 million people of which about 0.8 million live in or in the vicinity of the capital Oslo. The livestock production is targeted for the national market. Table 1 gives an overview of the livestock population and the number of animals slaughtered in 2003.

Until 1994 there was a general ban on the import of live animals and animal products to Norway. Live animals could only be imported if a derogation was given by the Veterinary Authorities. Consequently, there have been very few imports of live animals to Norway. Table 2 shows the number of live animals and animal products imported to Norway in 2002 and 2003.

Table 1. The livestock population in Norway and the number of slaughtered animals in 2003

	No.* of		
Animal category	**Herds**	**Animals**	**Slaughtered animals**
Cattle	23,600 [1]	949,600 [1]	333,700 [2]
Dairy cow**	16,100 [1]	252,300 [1]	-
Suckling cow**	4,100 [1]	42,600 [1]	-
Combined production (cow)**	1,400 [1]	33,900 [1]	-
Goat	1,100 [1]	49,500 [1]	19,500 [2]
Dairy goat**	600 [1]	45,800 [1]	-
Sheep	-	2,415,400 [1]	1,214,300 [2]
Breeding sheep > 1 year**	18,400 [1]	927,800 [1]	-
Swine	4,000 [1]	781,000 [1]	1,339,500 [2]
Breeding animal > 6 months**	2,300 [1]	60,000 [1]	-
Fattening pig for slaughter	3,600 [1]	419,000 [1]	-
Poultry			
Egg laying hen (> 20 weeks of age)	2,900 [1]	3,214,600 [1]	2,156,700 [2]
Flocks > 250 birds**	980 [1]	-	-
Broiler	500 [2]	-	40,372,400 [2]
Turkey, duck and goose for slaughter	200 [1]	311,600 [1]	904,500 [2]
Flocks > 25 birds**	79 [1]	-	-
Ostrich	26 [1]	330 [1]	-

[1)] Register of Production Subsidies as of 31 July, 2003, [2)] Register of Slaughtered Animals.
* Numbers >100 rounded to the nearest ten, numbers > 1000 rounded to the nearest hundred.
** Included in above total.

Table 2. Import of live animals and animal products to Norway in 2002 and 2003

		2002*		2003*	
Species	**Imported product**	No. of animals or products	No. of consignments	No. of animals or products	No. of consignments
Cattle	Live animals	-	-	17	1
	Semen (doses)	40,943	49	<180,000	47
	Embryos	88	5	<100	20
Swine	Live animals	2	1	6	2
	Semen (doses)	80	8	<200	21
Sheep	Semen (doses)	525	1	-	-
Goat	Live animals	33	1	92	7
Reindeer	Live animals for slaughter	2,439	26	-	-
Fur animal	Live animals	2,663	11	59	3
Poultry	Day-old chicks	31,030	8	8,500	19
	Eggs	240	2	-	-
Turkey	Day-old chicks	5,689	2	-	-
	Eggs	7,500	1	-	-
Duck and goose	Live birds	38	2	-	-
Halibut	Live fish	154,000	5	30,000	1
Turbot	Live fish	1,175	4	750	2
	Milt	25	1	-	-
Atlantic Salmon	Live fish	22,100	1	-	-

* Data from the Norwegian Animal Health Authority.

As a consequence of the European Economic Area (EEA) agreement which came into force in 1994, the trade of certain animals and products within the area was regulated through EU harmonised directives, and the general ban on the import of these animals and animal products to Norway was lifted. The interest in import of live animals increased in general during that decade. The authorities encouraged beef production, and the need for suckling cows was met by import of live animals.

The cattle population

Approximately 17,500 dairy herds were registered in Norway in 2003 of which approximately 1,400 also kept suckling cows. The average number of dairy cows per herd was 15.9. The number of specialized beef herds with at least one suckling cow was about 4,100 with a mean number of 9.3 suckling cows per herd. There is a downward trend in the size of the Norwegian cattle population over the last twelve years (Figure 1). The number of cows and herds in the dairy production industry is decreasing.

From 1980 to 1986, approximately 560 cattle were imported. There were no imports from 1987 to 1990. The European Economic Agreement in 1994 allowed more imports of live cattle. Nevertheless, as seen in Figure 2, the number of imports has been limited and most imported animals came from Sweden and Denmark. Close to 100% of the imports have been beef cattle.
In 2003, 17 live cattle were imported to Norway (Table 2).

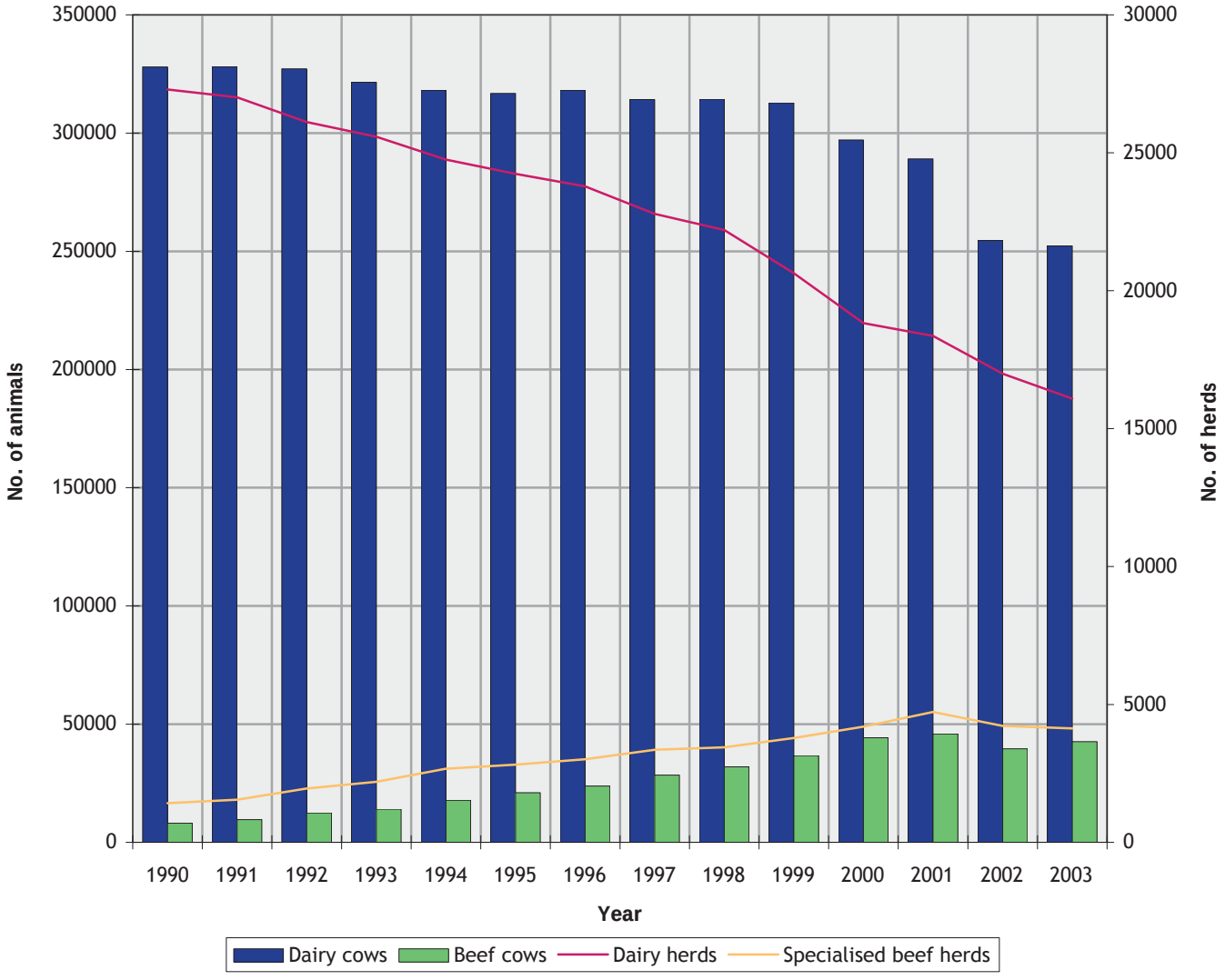


Figure 1. The number of dairy and beef cows in holdings with specialized dairy and beef production during the time period 1990-2003 (Statistics Norway and Register of production subsidies (RPS) for 2003).

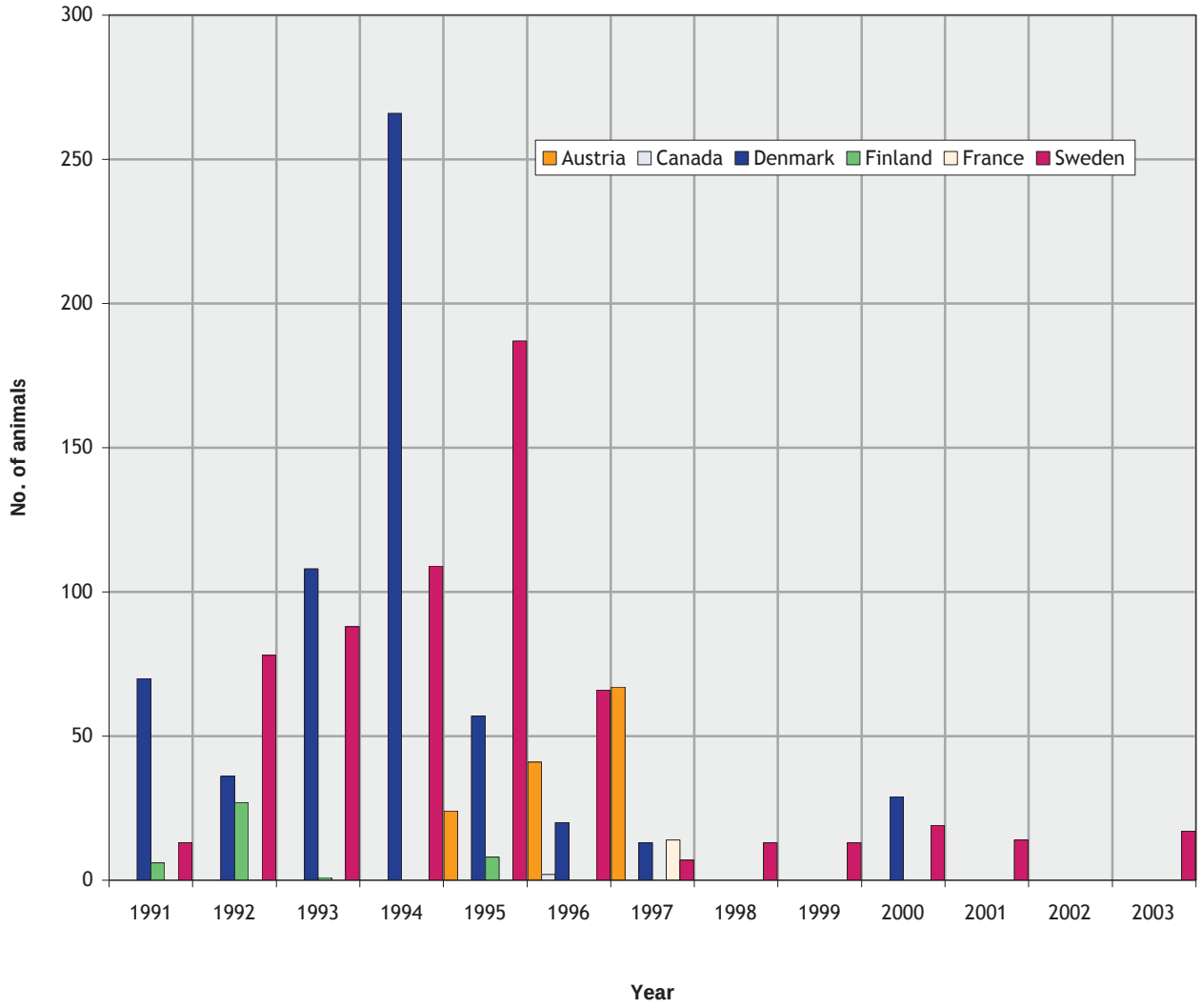


Figure 2. Imports of live cattle to Norway during the time period 1991-2003.

Table 3. The number of herds and the average herd size in the Norwegian commercial swine population

Category	No. of herds	Average herd size	
		Sows	Slaughter swine
Elite and multiplier breeding herds [1)]	178	-	-
Integrated herds [2)]	1,947	25.8	127.8
Piglet producing herds [2)]	368	22.9	
Fattening herds [2)]	1,617		123.8

Data from [1)] The Norwegian Pig Health Service and [2)] Register of Production Subsidies (RPS) as of 31 July 2003.

The swine population

The Norwegian swine population is relatively small with the pork and swine products destined for the local or national market. In 2003, about 1.3 million swine were slaughtered. Table 3 gives the distribution of the herds according to production structure.

The population consists of approximately 60,000 breeding swine aged more than six months. A national breeding programme is organised by the industry. The approximately 180 approved elite and multiplier breeding herds house only 5% of the live sows, while more than 95% of the sows purchased on the national market are raised in these herds. The swine population is denser in some counties and about 50% of the swine production is concentrated in Hedmark, Oppland, Rogaland and Nord-Trøndelag. The number of live animals imported during the time period 1991 to 2003 are given in Figure 3.

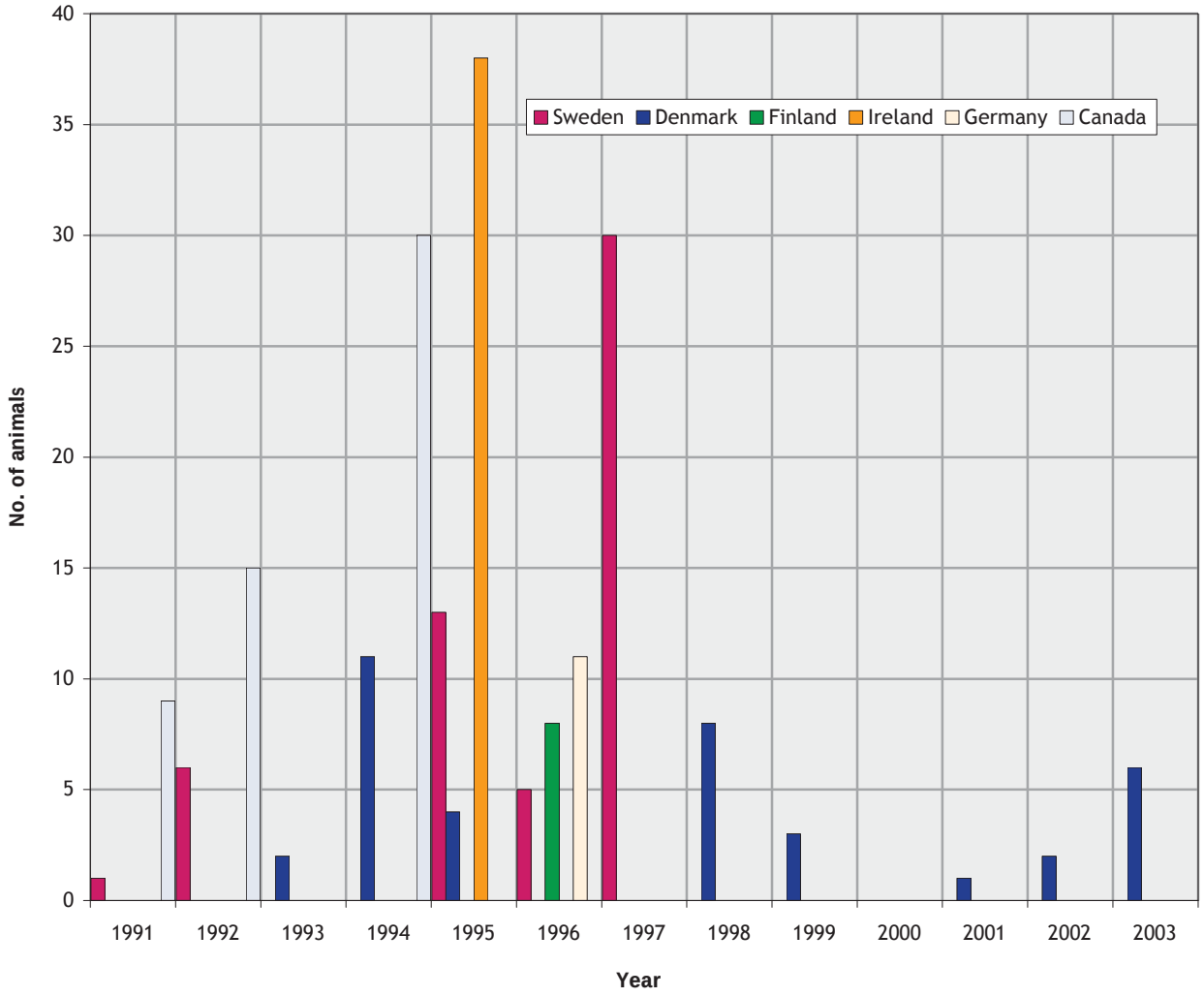


Figure 3. Import of live swine to Norway during the time period 1991-2003.

The sheep population

The Norwegian sheep population consists of approximately 927,000 sheep older than one year. The sheep flocks are widely distributed over the country, with the greatest population found in the south-west. The sheep population consists of combined meat and wool producing breeds, with the dala, spæl, steigar and rygja breeds predominating. Each year about 1.2 million sheep are slaughtered and approved for human consumption. Only a few live animals have been imported since the 1970s.

The goat population

The Norwegian goat population is comprised of approximately 46,000 dairy goats and principally composed of one Norwegian breed. The goat flocks are located in some mountainous regions in the southern part of the country, in the fjord districts of the western part, and in the counties of Nordland and Troms in northern Norway. The main product is milk used for cheese production. About 20,000 goats are slaughtered and approved for human consumption each year. Only a small number of live animals have been imported since the 1970s.

The poultry population

The Norwegian poultry production is strictly regulated and the population has a hierarchical structure. Egg and broiler meat production are the most important branches, but the production and consumption of turkey is increasing slightly. Figure 2A shows the location and structure of the Norwegian layer population comprising three hatcheries, about 15 pullet rearing farms and about 970 commercial layer farms. The layer population consists of two white layer strains (Lohmann white and Shaver white).

The commercial broiler production takes place in three hatcheries with two strains (Cobb and Ross), about 70 breeding farms with parent flocks and about 500 commercial broiler flocks. None of these farms is located in the northern part of Norway as shown in Figure 2B.

The layer and broiler industry import day-old grand parent flocks mainly from Sweden, but in 2003 also some small flocks were imported from Great Britain, France, Canada and the USA.

The population of farmed fish and shellfish

Aquaculture is an important industry for Norway and the value of exported Atlantic salmon and rainbow trout represents about 2% of the total value of all exports. Atlantic salmon is the most important species in the fish and shellfish farming industry. Hordaland and Nordland are the major counties for seawater farms producing Atlantic salmon. The production of farmed fish and shellfish is increasing although a small reduction was observed for trout in 2003 (Table 4).

The import of live fish in 2003 consisted only of a few consignments of halibut and turbot for the aquaculture industry (Table 2).

Table 4. Production volume of the most important species in Norwegian aquaculture during the time period 1992-2003[1)]

Year	Atlantic salmon (ton)	Trout (ton)	Cod (ton)	Arctic char (ton)	Halibut (ton)	Blue mussels (ton)	Scallops [2)] (1,000 pieces)	Oysters (1,000 pieces)
1992	141,000	-	-	-	-	-	-	-
1993	170,000	-	-	-	-	-	-	-
1994	207,000	-	569	262	63	542	14	1,085
1995	249,000	-	284	273	134	388	206	325
1996	292,000	40,000	191	221	138	184	92	526
1997	316,000	34,000	304	350	113	502	159	147
1998	343,000	47,000	199	190	290	309	159	510
1999	412,000	50,000	149	426	450	542	1,600	365
2000	424,000	47,000	200	300	400	659	2,200	583
2001	418,000	60,000	300	300	500	851	3,150	833
2002	450,000	83,000	1,500	300	300	2,000	2,800	300
2003	520,000	71,000	2,500	300	500	2,600	-	-

[1)] Data from The Directorate of Fisheries, [2)] From the wild population.

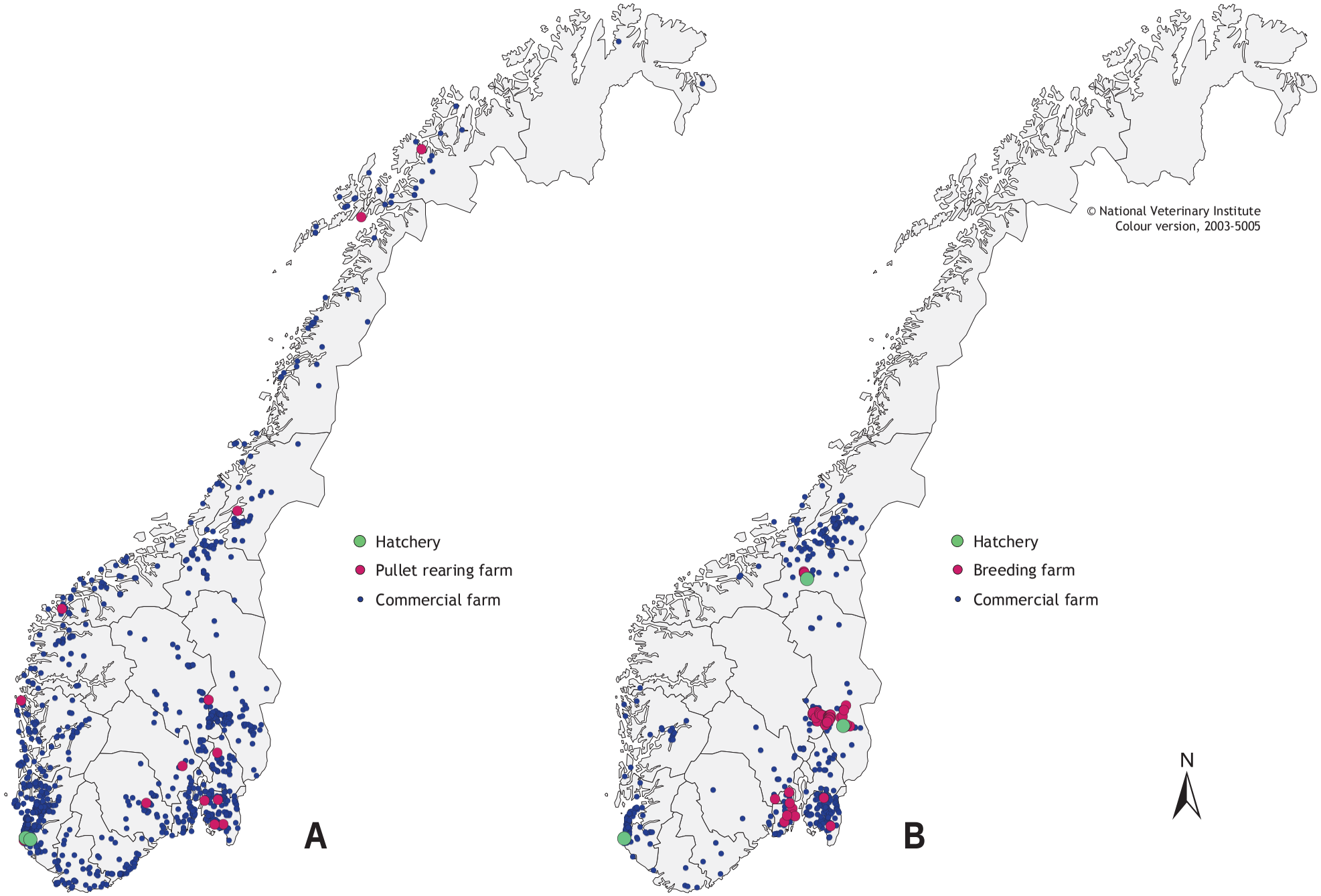


Figure 1. Geographical location of the farms included in the layer population (A) and in the broiler population (B) in Norway in 2003.

The surveillance and control programmes for *Salmonella* in live animals, eggs and meat in Norway

Annual report 2003

Petter Hopp
Bjarne Bergsjø
Torkjel Bruheim
Kjell Flesjå
Hanne Nilsen
Kjell Nyberg

Veterinærinstituttet
National Veterinary Institute

Introduction

The occurrence of *Salmonella* in Norwegian production animals and animal products is very low compared to most other countries. The number of *Salmonella* positive samples in Norwegian production animals has constantly remained at a very low level during the last decades.

The recorded incidence of human salmonellosis has increased in Norway during the last three decades. Since 1998, the annual incidence of human salmonellosis has remained between 1,400 and 1,900 with approximately 1,500 cases reported in 2003 (1). About 80% of the patients with salmonellosis have acquired the infection abroad. Meat produced in Norway is not considered a source of indigenous human S*almonella* infections.

It is very important to maintain this favourable situation in Norway. In connection with the Norwegian negotiations for membership in the European Union, the Norwegian *Salmonella* control programme was established (2). The programme was launched in 1995, simultaneously with comparable programmes in Sweden and Finland (3, 4).

The Norwegian *Salmonella* control programmes for live animals, eggs and meat, consists of two main parts; surveillance and control. The programmes covers live animals (pigs, cattle and poultry), and fresh meat (pigs, cattle and sheep) and poultry meat (2). The programme is approved by the EU Commission (EFTA Surveillance Authority Decision No. 68/95/COL of 19.06.95), allowing Norway to require additional guarantees regarding *Salmonella* when importing live animals and feed and food products of animal origin from the European Union.

The surveillance programmes for live animals and fresh meat and poultry meat are based on bacteriological examination for *Salmonella*. Isolation of any *Salmonella* sp. is notified to the authorities responsible for the programmes. The Animal Health Authority (from 2004, The Norwegian Food Safety Authority) maintains overall responsibility for the *Salmonella* surveillance and control programme for live animals, while the Norwegian Food Control Authority (from 2004, The Norwegian Food Safety Authority) is responsible for the *Salmonella* surveillance and control programme for fresh meat and poultry meat. The National Veterinary Institute coordinates both surveillance programmes, examines the faecal samples and publishes the results in monthly and annual reports. The Municipal Food Control Authorities perform the examination of samples collected at slaughterhouses and cold stores.

Aims

The aims of the programmes are to ensure that Norwegian food animals and food products of animal origin are virtually free from *Salmonella*, to provide reliable documentation of the prevalence of *Salmonella* in the livestock populations and their products, and to prevent an increased occurrence of *Salmonella* in Norway.

Materials and methods

The *Salmonella* surveillance and control programme for live animals includes examination of faecal samples from swine and poultry, and lymph node samples from cattle and swine. The *Salmonella* surveillance and control programme for fresh meat and poultry meat includes examination of swab samples from cattle, swine and sheep carcasses, neck skin samples from poultry and samples of minced meat from slaughterhouses and cold stores.

The number of samples examined in the different parts of the programmes is sufficient to detect at least one *Salmonella*-positive sample if the prevalence in the population is at least 0.1%, with a confidence level of 95%. When *Salmonella* is isolated, action is taken to eliminate the infection, prevent transmission, and prevent contamination of food products.

Sampling scheme for live animals

Swine

In Norway there are approximately 175 elite and multiplier breeding herds for swine. More than 95% of marketed breeding animals are purchased from these herds. All elite and multiplier breeding herds are surveyed annually at herd level. Pooled faecal samples are collected from all pens (up to a maximum of 20) containing piglets aged two to six months. If there are less than three pens of piglets at this age, additional individual faecal samples are collected from all sows (up to a maximum of 59) (5).

The total pig population is surveyed by collecting samples from a representative proportion of all pigs slaughtered in Norway. A total of 3,000 lymph node samples from swine (equally distributed on sows and slaughter pigs) are collected at the slaughterhouses. The sample size for each slaughterhouse ranges from 20 to 240 and is based upon the number of onsite slaughtered animals in relation to the national total. The sampling is distributed evenly throughout the year (6).

Table 1. Sampling of breeders (simplified)

Category of poultry		Time of sampling	Sample material
Grandparents	Day old	Day 1	Organs or meconium
	Rearing	1-2 weeks, 4 weeks, 9-11 weeks and 13-14 weeks	Faecal samples
	Egg production* -from the house	Monthly	Faecal samples
	-in the hatchery	Every 2nd week of production	Organs or meconium
Parents	Day old	Day 1	Organs or meconium
	Rearing	4 weeks and 2 weeks before start of production	Faecal samples
	Egg production* - in the hatchery	Every 2nd week of production	Organs or meconium

* In small hatcheries (< 1,000 eggs per year) a modified sampling scheme is used, with sampling from the house every two weeks.

Cattle

The surveillance is based on sampling a representative proportion of all cattle slaughtered in Norway. A total of 3,000 lymph node samples from cattle are collected at the slaughterhouses. The sample size for each slaughterhouse ranges from 20 to 100 and is based upon the number of onsite slaughtered animals in relation to the national total. The sampling is distributed evenly throughout the year (6).

Poultry

All breeding flocks and commercial production flocks, except layer flocks with less than 250 birds, are included in the surveillance programme. All breeder flocks are certified and the sampling is performed in accordance with the Zoonosis Directive (Council Directive 92/117/EEC) (Table 1). All broiler flocks and flocks of turkeys, ducks and geese other than breeders are sampled one to three weeks before slaughter (faecal samples), while layer flocks are sampled twice during the rearing period and once or twice during the egg laying period (2).

Clinical cases - all species

Any infection with any *Salmonella* serotype in any animal species is notifiable in Norway and animals with clinical symptoms that could be attributed to salmonellosis should be submitted to the National Veterinary Institute for bacteriological examination. In addition, all sanitary slaughtered animals are tested for the presence of *Salmonella*.

Sampling scheme for fresh meat and poultry meat

Swab samples from carcasses

The testing of slaughtered pigs, cattle and sheep for *Salmonella* is done by swabbing carcass surfaces. For each species, 3,000 swab samples are collected at the slaughterhouses. The sample size for each slaughterhouse is based upon the number of onsite slaughtered animals in relation to the national total. The number of swab samples of cattle and swine from each slaughterhouse equals the number of lymph node samples. The number of swab samples of sheep ranges from 20 to 160 per slaughterhouse. The sampling is distributed evenly throughout the year. The sampling is done before the carcasses are refrigerated, near the end of the slaughter line. Approximately 1,400 cm^2 per carcass is swabbed (somewhat less for sheep) for each sample (6).

Neck skin samples

Pieces of neck skin are used for *Salmonella* testing in broilers, turkeys, ducks and geese. At each slaughterhouse, a minimum of five neck skin samples is collected per day and at least one sample must be taken from each flock slaughtered on a single day. This corresponds to approximately 10,000 annual samples.

Food products

The surveillance and control programme in cutting plants and cold stores examines the production hygiene. The samples can be taken from minced meat, from the equipment or from trimmings. Each sample consists of 25 grams of meat. Each production line is sampled separately. The sampling is done randomly during operation.

Pre-packed fresh meat intended for cold stores does not have to be examined if originating from cutting plants which are included in the programme. Fresh packed or repacked meat should be sampled. The number of samples taken in cutting plants and cold stores is given by the production capacity of the plant, and ranges from one sample per week to two per year (6).

Laboratory methods

The lymph node sample from each animal is homogenized and one half of the sample is pooled together with four other samples before bacteriological examination. Swab samples are pooled in groups of five before testing. Each neck-skin sample is divided into two equal parts. One part is pooled with four to eleven other samples. The other half of the lymph node and neck skin samples are stored separately at 4°C until the results of the bacteriological examination are ready. If the pooled sample is confirmed positive for *Salmonella*, the individual samples are examined separately.

Microbiological examination of the samples is carried out according to the Nordic Committee on Food Analysis Method No. 71, slightly amended to make the method applicable to the various kinds of materials. This is a qualitative bacteriological method based on selective enrichment and cultivation. All positive samples are confirmed and serotyped by a reference laboratory.

Results

Live animals

Swine

A total of 2,377 faecal samples from 154 elite and multiplier breeding herds (including AI centres and testing stations) were examined in 2003 (Table 2). *Salmonella* was not detected in any of the samples. A total of 2,996 lymph node samples from slaughtered pigs were examined, approximately 28% of the samples from sows and 72% from slaughter pigs. Two samples were positive for *Salmonella* (Table 3) giving an estimated *Salmonella* prevalence of 0.07% (0.01% - 0.16%) (95% confidence interval) at the individual carcass level.

Cattle

In 2003, a total of 2,554 lymph node samples from cattle were examined (Table 3). Two samples were positive for *Salmonella* (Table 3) giving an estimated *Salmonella* prevalence of 0.08% (0.01% - 0.19%) (95% confidence interval) at the individual carcass level. For one of the positive pooled lymph node sample it was not possible to identify the individual positive animal.

Poultry

A total of 6,899 samples from 1,454 different holdings were examined (Table 4). *Salmonella* Typhimurium was detected in one sample from a broiler flock. *Salmonella* Typhimurium was again detected in the first follow up sampling, but were not detected in the second follow up sampling at the holding.

Fresh meat and fresh poultry meat

Swab samples from cattle, sheep and swine carcasses

A total of 8,318 swab samples from 48 slaughterhouses were examined in 2003 (Table 5). *Salmonella* was not detected in any of the samples.

Neck skin samples from poultry

A total of 7,183 neck skin samples from poultry were examined in 2003. *Salmonella* was not detected in any of the samples. The samples came from all the eight poultry slaughterhouses in Norway. Nearly 80% of the samples came from broilers, 10% from layers and 10% from other species (turkey, duck and goose).

Cutting plants and cold-stores for fresh meat and poultry meat

A total of 2,353 samples of minced meat from 106 different plants were examined.

Salmonella diarizona (61:k:1,5,7) was detected in one sample originating from sheep meat. *Salmonella diarizona* of the same serotype has previously been found from sheep in this region.

Table 2. Sampling in elite and multiplier breeding herds in the *Salmonella* surveillance and control programme in 2003

Herd category	No. of herds sampled (total*)	No. of samples examined	No. of positive samples	*Salmonella* serotype
Elite breeding herds	61 (67)	885	0	
Multiplier herds	90 (98)	1,412	0	
A.I. centres and testing stations	3 (5)	80	0	

* Total number of herds is estimated as elite and multiplier breeding herds per 1 January 2003 excluding herds which ended breeding activity during 2003 before being tested.

Table 3. Number of individual lymph node samples from cattle and swine examined in the surveillance and control programme for *Salmonella* in 2003

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	*Salmonella* serotype
Cattle	40 (44)	2,554	2	*S.* Typhimurium, *S.* Senftenberg
Slaughter pigs	28 (32)	2,159	1	*S.* Typhimurium
Sows	20 (32)	837	1	*S.* Hessarek

* Slaughterhouses where the number of slaughtered animals of a species is less than 100 according to the Slaughter Statistics for 2003, are not included.

Table 4. Sampling of poultry holdings in the *Salmonella* surveillance and control programme in 2003

Poultry breeding flocks	No. of samples tested	No. of holdings tested	No. of positive holdings	*Salmonella* serotype
Grandparents				
Layers	24	3	0	
Broiler production	17	1	0	
Parents				
Layers	169	4	0	
Meat production - Broilers	575	74	0	
- Turkeys	113	5	0	
- Ducks	13	2	0	
- Geese	1	1	0	
Total – Breeders	**1,201**	**101**	**0**	
Other commercial poultry				
Pullets	262	17	0	
Layers	1,546	827	0	
Meat production - Broilers	3,633	515	1	*S.* Typhimurium
- Turkeys	386	72	0	
- Ducks	35	5	0	
- Geese	1	1	0	
Total - Non breeder holdings	**5,698**	**1,375**	**1**	
Total	**6,899**	**1,454**	**1**	

Table 5. Number of swab samples from carcasses examined in the surveillance and control programme for *Salmonella* in 2003

Species	No. of slaughterhouses sampled (total*)	No. of samples examined	No. of positive samples	*Salmonella* serotype
Cattle	42 (44)	2,600	0	
Swine	30 (32)	2,947	0	
Sheep	31 (38)	2,758	0	

* Slaughterhouses where the number of slaughtered animals of a species is less than 100 according to the Slaughter Statistics for 2003, are not included.

Discussion

The results from the *Salmonella* surveillance programme in 2003 documents that the Norwegian cattle, swine, sheep and poultry populations are only sporadically infected with *Salmonella*. This is in accordance with previous findings (7, 8). The estimated prevalence is below 0.1% in any of the examined populations for any of the years the surveillance programme for live animals has run. The number of positive samples has never exceeded 10 in total per year. *S.* Typhimurium has been isolated most frequently, while *S.* Enteritidis has never been found by the surveillance programme.

Between 15% and 25% of the recorded human cases of salmonellosis are domestic in origin showing that domestic food products of animal origin represent a minor risk with regard to *Salmonella*-infection in humans. In 2002 it was shown that two clones of *Salmonella* in the wild fauna (wild birds and hedgehogs) represented a risk of infection in humans, especially to children under four years of age. Such wild animal reservoirs may also be considered a risk of infection in farm animals. As no increase in prevalence of *Salmonella* has been demonstrated in the programme, it may be assumed that farm animal populations are well protected from these reservoirs.

In parts of the surveillance programme pooled samples from individual animals are examined. Several times it has been difficult to trace the bacteriological findings back to the individual samples, making it difficult in the follow-up procedure to identify the affected farm.

The animal production in Norway has for the past years, undergone several structural changes as the number of farms has decreased while the size of the farms has slightly increased. But the Norwegian herds are still relatively small compared to most other European countries. The number of swab and lymph node samples examined per species should have been 3,000 per year. This year a negative trend in sample size has been broken and the required sample size was nearly reached for swine, but not for cattle and sheep. It is expected that by closer follow up the personnel taking and reporting the sample, the sample size will be reached.

The production of poultry meat produced in Norway has increased over the past years and reached nearly 46,000 tons in 2002. The percentage distribution between the various poultry categories were 82% broiler meat, 6% hen and 12% turkey. The number of neck skin samples examined should, according to the sampling criteria, not decrease because the sample size per slaughterhouse is based on the number of poultry flocks slaughtered. The relative proportion of turkey samples is somewhat smaller than what would be expected based on the production volume.

References

1. Trends and sources of zoonotic agents in animals, feedingstuffs, food and man in Norway 2002, 2003. Annual report according to Council Directive 92/117/EEC 2002. Norwegian Zoonosis Centre.

2. The Norwegian *Salmonella* surveillance and control programmes for live animals, eggs and meat. Veterinary and Food Department, Norwegian Ministry of Agriculture. 1998.

3. The Swedish *Salmonella* control programmes for live animals, eggs and meat. National Veterinary Institute, Swedish Board of Agriculture, National Food Administration. 1995.

4. The Finnish *Salmonella* control programmes for live animals, eggs and meat. Veterinary and Food Department, Finnish Ministry of Agriculture and Forestry. 1994.

5. Forskrift om overvåking av og kontroll med forekomsten av *Salmonella* hos levende dyr av 31.01. 1995 nr. 107. (Regulations of surveillance and control of occurrence of *Salmonella* in live animals.)

6. Instruks til det kommunale næringsmiddeltilsynet om overvåkning av og tiltak mot salmonella i ferskt kjøtt og ferskt fjørfekjøtt av 20.02.1996 nr 1474.

7. Fredriksen, B., Bergsjø, B., Bruheim, T., Nyberg K., Flesjå, K.I., Skjervheim, M., 2002. The surveillance and control programmes for *Salmonella* in live animals, eggs and meat in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 19-32.

8. Jarp, J., Bergsjø, B., Bruheim, T., Nyberg K., Flesjå, K.I., Skjervheim, M., 2003. The surveillance and control programmes for *Salmonella* in live animals, eggs and meat in Norway. In: Tafjord Heier, B. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 20-28.

Examinations of residues of prohibited substances in live animals in Norway

Annual report 2003

Jens Børsum
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

The programme for monitoring residues of prohibited substances in live animals has been administered by the Norwegian Animal Health Authority since 1999 (1, 2). Prior to this, surveying residues in both animal products and live animals was carried out by the Norwegian Food Control Authority.

Sampling is carried out in accordance with EU Directive 96/23 (3), which determines the sampling frequencies in bovines, pigs and poultry based upon slaughter statistics from 2001.

The following prohibited substances are included in Group A and are covered by the programme:

1. Stilbenes, stilbene derivatives, salts and esters
2. Thyrostatics
3. Steroids
4. Resorcyclic acid lactones (zeranol)
5. Beta-agonists
6. Annex IV substances (chloramphenicol, nitrofuranes, metronidazole and dimetridazole)

Aim

The aim of the present programme is to ensure food safety by monitoring live animals for the presence of prohibited substances (Table 2).

Materials and methods

The sampling plan for the various animal species is determined by the Norwegian Animal Health Authority, on the basis of earlier production (Table 1).
The programme includes sampling of urine and blood.

A national database consisting of all swine and cattle producers who apply for production subsidies (RPS) constitute the sampling frame for swine and cattle herds to be included in the programme for live animals. The RPS database includes information about the herd owners, herd localisation and the number of animals in different age categories. The register is owned by the Ministry of Agriculture and updated twice a year. The selection of herds was performed by simple random sampling by an automatic routine (SAS-PC System® Version 8e for Windows, SAS Institute Inc., Cary, NC, USA, 1999-2000). The sampling was also randomly distributed in time.

Information on each sample is registered in a protocol at the time of sampling and sent to a central registration unit. All samples are analysed within three months. Any prohibited substances detected are reported immediately.

Results

All analyses are carried out by national reference laboratories. The Norwegian laboratories are accredited by the Norwegian Accreditation and meet the requirements of the relevant ISO standards (9000, 90001, 90002). Substances A1, A3, A4 and A5 are analysed at the Hormone Laboratory, Aker University Hospital. Substances A2 are analysed at the National Veterinary and Food Research Institiute (EELA), Helsinki and substances A6 are analysed at the Laboratory for Veterinary Drug Residue Analysis in Food, Norwegian School of Veterinary Science.

Table 2 presents an overview of the number of samples tested in 2003 with respect to the sampling plan, and grouped according to substances.

No traces of prohibited substances were detected in any of the animals sampled.

Table 1. The sampling plan for 2003 based on the number of animals slaughtered or tons produced in 2001

Categories	Animals slaughtered 2001	Total no. of animals to be tested	No. of animals to be tested for Group A substances – live and slaughtered
Bovine	347,312 *	1,389 ** (0.4%)	804 (434 live, 370 slaugthered)
Porcine	1,317,498 *	659 ** (0.05%)	223 (13 live, 210 slaugthered)
Poultry	41,943 tons	179 **	114 (21 live, 93 slaughtered)

* Total number of approved carcasses.
** Includes both Group A and Group B substances, while only Group A substances are tested in this programme.

Table 2. The number of samples tested vs. planned

Substances	Bovines		Pigs		Poultry	
	Sampled	Planned	Sampled	Planned	Sampled	Planned
A1 Stilbenes	95	96	1	2	-	4
A2 Thyrostatics	34	34	2	2	-	4
A3 Steroids	94	96	1	3	-	3
A4 Resorcyclic acid lactones	89	96	-	3	-	3
A5 Beta-agonists	95	96	1	1	-	3
A6 Annex IV substances	14	16	2	2	-	4
Total A	**421**	**434**	**7**	**13**	**0**	**21**

Comments

Deviations from the sampling plan are due to inadequate implementation of the plan. Obtaining satisfactory samples from poultry remains a challenge due to problems with analysing waste from birds. Attempts to obtain suitable tissue samples from poultry have been unsuccessful in 2003. Sampling routines will be revised in 2004.

References

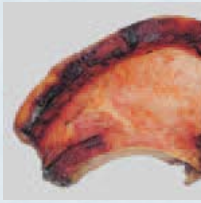
1. Børsum, J., 2002. Examinations of residues of prohibited substances in live animals in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 33-36.

2. Børsum, J., 2003. Examinations of residues of prohibited substances in live animals in Norway. In: Heier, B. T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 29-32.

3. Council Directive 96/23/EF, 1996. Control measures to be implemented with respect to specific substances and their residues in live animals and animal products, and repeal of Council Directives 85/358/EØF and 86/469/EØF and resolutions 89/187/EØF and 91/664/EØF.

Examinations of residues of veterinary drugs, prohibited substances and environmental contaminants in animal products in Norway

Annual report 2003



Jens Børsum

Veterinærinstituttet
National Veterinary Institute

Introduction

Surveying residues in animal products has been carried out in Norway since 1985, starting with samples from bovine and porcine products. Since 1988, the Norwegian Food Control Authority has been in charge of the programme. In 1993 the programme was expanded to include sheep, poultry and reindeer products in accordance with EU Directive 86/469. It was further expanded in 1999 to include milk, eggs, honey and fish, and by substantially increasing the number of samples and substances tested for in the programme. The programmes for residues in live animals and fish were taken over by the Norwegian Animal Health Authority and the Directorate of Fisheries, respectively.

To prevent consumption of animal products that contain potentially harmful residues, the Residue Control Regulation (RCR) was introduced (1). This aims to prevent production, import and sale of products containing residues of prohibited substances, contaminants and veterinary drugs above Maximum Residue Limits (MRL). The legislation implements EU Directive 96/23 and requires control measures for any activity in agricultural and animal production (2).

The RCR determines MRLs for veterinary drugs. The use of veterinary drugs without MRLs in production animals is prohibited.

Aim

The aim of the present programme is ensure food safety by monitoring the occurrence of residues of veterinary medicines, prohibited substances and environmental contaminants in animal products and foods. The programme also provides data to satisfy export documentation requirements from the EU, USA and Switzerland.

Materials and methods

Group of substances

EU regulations define the products and groups of substances to be included in the programme (Appendix). Each country may select the specific substances to be monitored. In Norway this is based on data from the Norwegian Medicines Agency, as well as advice from the Norwegian School of Veterinary Science, Aker University Hospital and the National Veterinary Institute.

Sampling plan

The sampling plan for the various animal species and foodstuffs is determined on the basis of earlier production (Table 1). The plan is designed to ensure even sampling throughout the year and throughout the country. Information on each sample is registered in a protocol at the time of sampling and sent to the central registration unit.

Table 1. The number of animals slaughtered and production figures for animal products in Norway in 2001

Categories	Production
Bovine	347,312 *
Porcine	1,317,498 *
Sheep	1,185,681 *
Equine	2,428 *
Reindeer	1,005 tons
Poultry	41,943 tons
Milk	1,540 mill liter
Eggs	45,111 tons
Honey	622 tons

* Total number of approved carcasses.

Laboratory analysis

Samples are analysed within three months of sampling. Values exceeding MRLs and any prohibited substances detected are reported immediately.

All analyses are carried out by national reference laboratories. The Norwegian laboratories are accredited by the Norwegian Accreditation and meet the requirements of the relevant ISO standards (9000, 90001, 90002). Substances A1, A3, A4, A5 and B2d are analysed at the Hormone Laboratory, Aker University Hospital. Substances A2 are analysed at the National Veterinary and Food Research Institute (EELA), Helsinki. Substances A6, B1, B2b, e, and f are analysed at the Laboratory for Veterinary Drug Residue Analysis in Food, the Norwegian School of Veterinary Science (NVH). Substances B2a and c are analysed at the Laboratory for Drugs Analysis, NVH. Substances B3a and b are analysed at the Laboratory of Environmental Toxicology, NVH, and the Plant Protection Center, Ås. Substances B3c and d are analysed at the Section of Chemistry, National Veterinary Institute.

Results and comments

Table 2 presents an overview of the number of animals/ foods sampled in 2003.

General

In general, there were few deviations from the sampling plan.

Anticoccidials

The anticoccidial narasine was detected in one egg. The concentration was found to be 50 µg/kg.

Heavy metals

Residues of environmental contaminants (cadmium and lead) exceeding MRLs were detected in samples from 1 bovine, 14 sheep and 36 reindeer. All but nine of these were in liver and kidney samples. The bovine sample was taken by the Municipal Food Control Authority (NMT) - Etne, Dølen og Vindafjord. Of the ovine samples two were sampled by NMT Gauldal, two by NMT Midt-Rogaland, three by NMT Oslo, five by NMT Etne, Dølen og Vindafjord and two by NMT Sør-Innherrad. Of the reindeer samples, ten were from NMT Midt-Finnmark, eight from NMT Øst-Finnmark, ten from NMT Sør-Innherrad and eight from NMT Gauldal. Analyses on heavy metals are initially carried out on samples of liver and kidney from bovines, pigs, sheep and reindeer. When residues exceed MRLs, samples of muscle from the same animals are analysed. In horses, only samples of muscle are analysed.

Heavy metals are found in variable concentrations, both naturally and as a result of contamination. Heavy metals may accumulate in organs throughout life as a result of environmental contamination.

Table 2. The total number of animals/foods in the surveillance and control programme in 2003

Substances	Bovines		Pigs		Sheep		Horses		Poultry		Reindeer		Milk		Eggs		Honey	
	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.	No.	Pos.
A1 Stilbenes	65		40		24				10		2							
A2 Thyrostatics	45		20		10				10		2							
A3 Steroids	65		40		22				5		2							
A4 Resorcyclic acid lactones	70		40		25				10		2							
A5 Beta-agonists	60		29		13				25		6							
A6 Annex IV substances	50		40		20				33		6		11		10		5	
Total A	**355**		**209**		**114**				**93**		**20**		**11**		**10**		**5**	
B1 Tiamulin (pigs); penicillin (milk)			30										47					
B1 Fluoroquinolones			30															
B1 Sulfonamides	50		50		50				43		20		39		40			
B1 Tetracyclines									43		20		38		40		5	
Total B1	**50**		**110**		**50**				**86**		**40**		**77**		**80**		**5**	
B2a Anthelmintics	60		40		50				5		30		51					
B2b Anticoccidials	10		10		10				43						50	1		
B2c Carbamates and pyrethroides	20		10		35				5						20		10*	
B2d Sedatives	20		50		35													
B2e NSAIDs	20		10		10		10		5									
B2f Glucorticoids	19		20				15						20				10*	
Total B2	**149**		**140**		**140**		**35**		**58**		**30**		**71**		**70**	**1**	**10**	
B3a Organochlorine compounds	19		20		15				10		10		19		20		10*	
B3b Organophos-phorous compounds	20		20		15				10				20				10*	
B3c Chemical elements	25	1	15		25	14	30		6		40	36	25		20		5	
B3d Mycotoxins	10		10		5				6				22					
Total B3	**74**	**1**	**65**		**94**	**14**	**30**		**32**		**50**	**36**	**86**		**40**		**15**	
Total B	**273**	**1**	**315**		**279**	**14**	**65**		**176**		**120**	**36**	**234**		**190**	**1**	**30**	
Total A+B	**628**	**1**	**524**		**393**	**14**	**65**		**269**		**140**	**36**	**245**		**200**	**1**	**35**	

*: 10 samples of honey are analysed for groups B2c, f, B3a and b in multiseries.
No.: Total number animals/foods in the covered period.
Pos.: Positive results (detection for banned substances or above MRLs or national limits for veterinary drugs and contaminants).
A6: Annex IV: chloramphenicol; nitrofuranes; dimetridazole, metronidazole.

References

1. Directive no 65, 2000. Control measures for residues of specific substances in foodstuffs, production animals and fish to ensure food safety (RCR). Norwegian Food Control Authority, Oslo, Norway.

2. Council Directive 96/23/EF, 1996. Control measures to be implemented with respect to specific substances and their residues in live animals and animal products, and repeal of Council Directives 85/358/EØF and 86/469/EØF and resolutions 89/187/EØF and 91/664/ EØF.

3. Veterinære lægemiddelrester i fødevarer 2003 - resultater fra den danske kontrol af veterinære lægemiddelrester, 2002. Ministeriet for Fødevarer, Landbrug og Fiskeri, Fødevaredirektoratet, Fødevarerapport 2003: 13; ISBN: 87-91399-16-5. www.fdir.dk

4. Klaasen, C.D., 2001. Casarett & Doull´s Toxicology. The basic science of poisons. 6th ed. McGraw-Hill, USA.

5. Adams, H.R., 1995. Veterinary Pharmacology and Therapeutics. 7th ed. Iowa State University Press/Ames, USA.

6. Food Residue Database, 2001. In: Research report no 46. The National Food Centre, Ireland.

7. Børsum, J., 2002. Examinations of residues of veterinary drugs, prohibited substances and environmental contaminants in animal products in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 37-43.

8. Børsum, J., 2003. Examinations of residues of veterinary drugs, prohibited substances and environmental contaminants in animal products in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 33-39.

Appendix

Group A - Prohibited substances

1. Stilbenes, stilbene derivatives, salts and esters
2. Thyrostatics
3. Steroids
4. Resorcyclic acid lactones
5. Beta-agonists
6. Annex IV substances. (incl. chloramphenicol, nitrofuranes, dimetridazole and metronidazol)

Group B - Veterinary drugs and contaminants

1. Antibacterial substances, (incl. sulphonamides, fluoroquinolones)
2. Other veterinary drugs
   - Antihelminthics
   - Anticoccidials
   - Carbamates and pyrethroids
   - Sedatives
   - NSAIDs
3. Environmental contaminants and other substances
   - Organochlorine compounds, incl PCBs
   - Organophosphorus compounds
   - Chemical elements
   - Mycotoxins

The surveillance and control programme for paratuberculosis in Norway

Annual report 2003

Ola Nyberg
Berit Djønne
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

Paratuberculosis was first diagnosed in cattle and goats in Norway in 1907 and 1934, respectively (1, 2). *Mycobacterium avium* subsp. *paratuberculosis* infection is a notifiable disease (List B) in cattle and goats in Norway and the disease in cattle is controlled by government restrictions and most often culling of the herd when the infection is confirmed. Affected herd owners are compensated by the government, which also covers the expenses involved in testing. In goat flocks, government restrictions combined with vaccination are used to control paratuberculosis. From 1967 to 2001, a live attenuated vaccine was used (3), whereas from October 2001 vaccination has been performed using an inactivated vaccine (4).

A national surveillance and control programme for paratuberculosis was established in 1996 (5).

Occurrence of the disease in Norway, control measures taken up to 1995, and results from the surveillance and control programmes from 1996 to 2002, are described in the annual report for 2001 (6) and 2002 (7).

Aim

The aim of the surveillance programme for paratuberculosis in 2003 was to estimate the prevalence of the infection in the Norwegian cattle population. In addition, goats from both vaccinated and unvaccinated flocks, sheep and llamas in limited numbers were screened for infection with *M. a. paratuberculosis*.

Materials and methods

Four animal species were in 2003 included in the surveillance and control programme for paratuberculosis, cattle, llamas, goats and sheep. Faecal samples from these species were collected on the farms, while organ samples were collected at slaughterhouses.

Active surveillance

Cattle

The group of herds from which the animals were selected for testing, consisted of all cattle herds delivering milk to the dairies in the sampling period and all beef cattle herds receiving state support according to recordings of July 2002. Two hundred herds were randomly selected and five faecal samples were collected from the five oldest cows in each herd.

In 1999, blood samples from animals older than 24 months in 287 randomly chosen herds (242 dairy herds and 45 beef herds) were examined for antibodies against *M. a. paratuberculosis* in an ELISA (6). Ten per cent of the animals were seropositive. These animals are monitored by faecal culture each year, and when slaughtered, organ samples are collected.

Llamas

The llama was recently introduced as a new species to Norway. A few animals have been imported from Sweden over the last five to six years. All llamas are included in the programme and faecal samples from animals over four years old should be collected each year. In addition, organ samples are collected from llamas at slaughter, and from animals that die at more than four years of age.

Goats

Thirty flocks in which the kids were vaccinated and 30 unvaccinated flocks were randomly selected. Faecal samples from the 10 oldest goats, or from sick goats, were collected.

Sheep

Fifty flocks were randomly selected. Faecal samples from the 10 oldest sheep, or from sick sheep, were collected.

Herds with restrictions

Samples collected from infected cattle herds, from infected flocks of small ruminants, or from contact herds are also included in the surveillance programme.

Passive clinical surveillance

Clinical surveillance has been a part of the programme since 2000. For cattle, special emphasis is placed on the collection of samples from animals with reduced milk production, loss of weight, diarrhoea lasting more than 14 days and animals that are over four years old. Not all of these criteria need to be met.

Sampled herds and animals

A total of 1,027 faecal samples and 45 organ samples were collected from cattle, while 624 faecal samples and 69 organ samples were collected from goats. A total of 500 faecal samples and 10 organ samples were collected from sheep, and 45 faecal samples and three organ samples were collected from llamas (Table 1).

Table 1. Number of samples collected for examination for *Mycobacterium avium* subsp. *paratuberculosis* in 2003

		Faecal samples no. of animals	Intestinal samples no. of animals	Total no. of animals	Total no. of herds
Cattle	Dairy and beef cattle	1,012		1,012	201
	Seropositive in 1999	2	5	6	6
	Suspected or imported cases	13	5	18	14
	Control of infected herds and contact herds		35	35	5
Goat	Vaccinated	298		298	30
	Unvaccinated	302		302	31
	Suspected cases		3	3	3
	Control of infected flocks and contact flocks	24	66	90	8
Sheep	Random sample	500		500	51
	Control of infected flocks and contact flocks	10	11	21	4
Llama		45	3	48	5

Histopathological examination

Samples from jejunum, ileum, ileocecal valve and mesenteric lymph nodes were examined histopathologically. The tissue was fixed in 10% neutral-buffered formalin, processed by routine methods and stained with haematoxylin and eosin (HE) and the Ziehl-Neelsen (ZN) method for acid-fast bacteria.

Bacteriological examination

The samples were decontaminated with 4% sodium hydroxide and 5% oxalic acid with 0.1% malachite green (8), and inoculated onto selective and non-selective Dubos medium with mycobactin (2 μg/ml) and pyruvate (4 mg/ml) (9). Incubation time was 16 weeks.
Mycobactin dependency, acid-fastness by Ziehl-Neelsen staining and presence of the insertion segment IS*900* by a PCR technique (10) were used to identify the isolates.

Results

Histopathological examination

Formalin fixed tissue samples from 45 cattle from 15 different herds were examined (Table 2). Histopathological lesions compatible with paratuberculosis and acid-fast bacteria were found in two animals.

A total of 69 goats from 9 different flocks were examined (Table 3). Sixty-eight goats came from vaccinated flocks and they were all either clinically suspected cases, or from infected flocks. Nine goats from three flocks had granulomatous lesions with acid-fast bacteria in the intestine and mesenteric lymph nodes.

Eleven sheep from two flocks were examined (Table 4). Seven sheep came from a combined flock with goats and beef cattle where the goats were infected. Four sheep came from a combined flock with goats which have been under restrictions because of infection with *M. a. paratuberculosis* since 1992, and where the goats have been vaccinated with a live vaccine in the same period. Histopathological lesions were not found and *M. a. paratuberculosis* was not isolated from any of the samples.

Bacteriological examination

A total of 1,072 cattle were examined for paratuberculosis by bacteriological methods (Table 2). *M. a. paratuberculosis* was found in organ samples from two cows in one herd. This beef cattle herd was stamped out early in 2003 because *M. a. paratuberculosis* was diagnosed in this herd in 2002.

Table 2. Results of histopathological and bacteriological examination of cattle in 2003

	Bacteriology			Histopathology		
Type of samples	No. of samples	No. of herds	No. of pos. samples	No. of samples	No. of herds	No. of pos. samples
Faeces	1,027	221	0			
Intestinal samples	45	15	2	45	15	2

Table 3. Results of histopathological and bacteriological examination of goats in 2003

	Bacteriology			Histopathology		
Type of samples	No. of samples	No. of flocks	No. of pos. samples	No. of samples	No. of flocks	No. of pos. samples
Faeces	610	63	8			
Intestinal samples	69	9	13	69	9	9

Table 4. Results of histopathological and bacteriological examination of sheep in 2003

	Bacteriology			Histopathology		
Type of samples	No. of samples	No. of flocks	No. of pos. samples	No. of samples	No. of flocks	No. of pos. samples
Faeces	510	52	0			
Intestinal samples	11	2	0	11	2	0

Table 5. Results of histopathological and bacteriological examination of llamas in 2003

	Bacteriology			Histopathology		
Type of samples	No. of samples	No. of herds	No. of pos. samples	No. of samples	No. of herds	No. of pos. samples
Faeces	45	4	0			
Intestinal samples	3	1	0	3	1	0

A total of 679 dairy goats from 72 flocks were examined for paratuberculosis by bacteriological methods (Table 3). *M. a. paratuberculosis* was isolated from 21 goats in eight flocks. Five of the flocks were also positive in 2002, while three flocks had not been detected previously. The goats in these flocks were vaccinated against paratuberculosis with a live attenuated vaccine.
A total of 521 sheep from 54 flocks were examined for paratuberculosis by bacteriological methods (Table 4). *M. a. paratuberculosis* was not isolated from any of the samples.

A total of 48 llamas from five herds were examined for paratuberculosis by bacteriological methods (Table 5). *M. a. paratuberculosis* was not isolated from any of the samples.

Discussion

The results from the national surveillance and control programme for paratuberculosis in 2003 showed that two of 1,072 examined cattle were infected by *M. a. paratuberculosis.* Both cases came from the same Aberdeen Angus herd which was diagnosed in 2002. All animals older than 24 months were examined when the whole herd were put down early in 2003. The number of examined cattle is low, and the true prevalence can not be estimated by this programme. The historical data, the examination of suspected cases and the ongoing programme indicate that the prevalence of *M. a. paratuberculosis* infection in Norway is very low.

Both in 2001 and 2002, the surveillance and control programme revealed two infected cattle each year. Two were sampled because they had clinical symptoms, the third through random sampling and the fourth because of contact with an infected herd many years ago. Two of the affected herds originate from the same herd, and are of Aberdeen Angus breed. The herd found by random sampling is a dairy herd, but possibly also linked to the Aberdeen Angus herd. The fourth case is situated in a different part of the country and has no link to the other cases. However, the herd is situated in an area with many infected goat flocks which at times share common pastures.

Of 679 examined goats, 21 were infected by *M. a. paratuberculosis.* All the positive goats came from flocks where vaccination is compulsory. This shows that vaccinated goats can excrete the bacterium in faeces and might infect other animals.

Sheep were included in the surveillance programme for the first time in 2002 with examination of samples from 369 sheep and two sheep were infected by *M. a. paratuberculosis*. One of the cases came from a combined herd with sheep and goats where *M. a. paratuberculosis* had been isolated from a goat in 2001. The other case was from a combined herd with beef cattle and sheep in which all animals were culled in early 2002 because *M. a. paratuberculosis* had been isolated in faeces from a cow that was clinically ill and culled in 2001. None of the sheep showed clinical symptoms.
In 2003, samples from 521 sheep were examined with no positive findings. The sheep population in Norway numbers approximately one million adult animals and the surveillance programme is not designed to estimate the prevalence of paratuberculosis among sheep in the country. Nevertheless, the results indicate that sheep may be infected by *M. a. paratuberculosis* from other species.

The number of samples from llama is reduced from 68 in 2002 to 45 in 2003. The number of llamas, however, is increasing slowly. This fact tells us that collecting faecal samples from llamas is difficult and some time dangerous. From some herds, not all animals will be sampled, and some samples will be picked from the ground. *M. a. paratuberculosis* has not been isolated from any of these samples.

References

1. Horne, H., 1908. Kronisk pseudotuberkuløs tarmbetændelse hos kvæg konstatert i Norge. (Cronic pseudo-tuberculous intestinal inflammation demonstrated in Norway). Nor. Vet. Tidsskr. 20, 70-77.

2. Holmboe, F.V., Slagsvold, L., 1934. Paratuberkulose hos sau og geit. (Paratubeculosis in sheep and goats). Skand. Vet. Tidsskr. 24, 573-585.

3. Saxegaard, F., Fodstad, F.H., 1985. Control of paratuberculosis (Johne's disease) in goats by vaccination. Vet. Rec. 116, 439-441.

4. García Marín, J.F., Tellechea, J., Gutiérrez, M., Corpa, J.M., Pérez, V., 1999. Evaluation of two vaccines (killed and attenuated) against small ruminant paratuberculosis. In: Proceedings of Sixth Int. Colloquium on Paratuberculosis pp. 234-241.

5. Djønne, B., Fredriksen, B., Nyberg, O., Sigurðardóttir, Ó.G., Tharaldsen, J., 2001. National bovine paratuberculosis program in Norway. Bull. Int. Dairy Fed. 364, 75-80.

6. Djønne, B., Nyberg, O., Fredriksen, B., Sigurðardóttir, Ó.G., Tharaldsen, J., 2002. The surveillance and control programme for paratuberculosis in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 45-54.

7. Nyberg, O., Djønne, B., 2003. The surveillance and control programme for paratuberculosis in Norway. In: Heier, B.T. (Ed) Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 41-47.

8. Berg Jørgensen, J., 1982. An improved medium for culture of *Mycobacterium paratuberculosis* from bovine faeces. Acta Vet. Scand. 23, 325-335.

9. Saxegaard, F., 1985. Isolation of *Mycobacterium paratuberculosis* from intestinal mucosa and mesenteric lymph nodes of goats by use of selective Dubos medium. J. Clin. Microbiol. 22, 312-313.

10. Sigurðardóttir, O.G., Press, C.M., Saxegaard, F., Evensen, O., 1999. Bacterial isolation, immunological respons and histopathological lesions during the early subclinical phase of experimental infection of goat kids with *Mycobacterium avium* subsp. *paratuberculosis.* Vet. Pathol. 36, 542-550.

The surveillance and control programme for bovine spongiform encephalopathy (BSE) in Norway

Annual report 2003

Mette Valheim
Bjørn Bratberg
Torkjel Bruheim
Helga Høgåsen
Torfinn Moldal

Veterinærinstituttet
National Veterinary Institute

Introduction

Surveillance for Bovine Spongiform Encephalopathy (BSE)

BSE became a notifiable disease in Norway 1 February 1991, and the first surveillance and control programme for BSE was launched 1 August 1998. The Norwegian Animal Health Authority was responsible for the implementation of the programme, while the National Veterinary Institute was responsible for laboratory analyses and reporting. The programme was initially based on passive surveillance (1998-2000), while active surveillance was introduced in May 2000. In the period 1998-2000 the samples were investigated by histopathological examination, but from 2001 the samples were examined by an ELISA method (Platelia® BSE ELISA, Bio-Rad) for detection of resistant prion protein (PrP^{Sc}). The clinically suspect animals were also investigated according to the OIE protocol by histopathological examination (1, 2). The number of samples examined in each category is presented in Table 1. BSE has never been detected in any of the examined animals.

Table 1. Examination for BSE of cattle sampled in the Norwegian surveillance program according to categories from 1998-2002

Reason for submission to the laboratory	1998-2000	2001	2002
Clinically suspect	78	14	2
Fallen stock		1,352	1,482
Emergency slaughtered		7,073	7,246
Ante-mortem animals		2,612	3,562
Imported slaughtered animals	19 *	88	39
Healthy slaughtered animals		2,400	9,907
Total	**97**	**13,539**	**22,238**

* all the samples were examined in 2000

Surveillance programme 2003

Programme outline

For 2003 Norway adjusted the surveillance programme in accordance with the Commission Regulations (EC) No 999/2001 and No 1494/2002 and the programme included examination of the following categories of cattle:

- clinically suspect animals irrespective of age
- all animals older than 24 months of age, which have died or been killed, but not slaughtered for human consumption (fallen stock)
- all emergency slaughtered animals older than 24 months
- all animals older than 24 months, with abnormal findings at ante-mortem examination, rejected for human consumption, or which died at the abattoir or during transport (referred to as ante-mortem animals)
- all slaughtered animals with unknown age or origin
- all imported cattle from any country irrespective of age and the over 24 month old progeny of imported female cattle
- 10,000 randomly selected healthy routinely slaughtered animals older than 30 months

Implementation

The farmers were responsible for reporting all cases of clinically suspect animals irrespective of age and fallen stock older than 24 months to the District Veterinary Officers (DVOs) of the Norwegian Animal Health Authority. They also had to report to the Municipal Food Control Authorities when delivering an imported animal or progeny of an imported female animal to slaughter. The DVOs forwarded the brain or the head from clinically suspect cattle and fresh material from the *medulla oblongata* sampled from fallen stock to the National Veterinary Institute, Oslo. Veterinary Officers at the Municipal Food Control Authorities collected the samples of the *medulla oblongata* at the abattoirs. All categories of samples except samples from healthy slaughtered animals were sent to the National Veterinary Institute, Oslo, while the samples from the healthy slaughtered animals were sent to the National Veterinary Institute, Trondheim within 24 hours in a cool insulated container.

Laboratory methods

Clinically suspect animals

The whole brain was divided midsagittally in two equal halves. One half was formalin-fixed and processed according to a standard routine protocol, embedded in paraffin, sectioned at 5 µm and stained with haematoxylin eosin (HE). Immunohistochemical staining for PrP^{Sc} was performed on selected sections using a monoclonal anti-PrP antibody (SAF 84, courtesy of J. Grassi, CEA, France).

From the unfixed brain half, tissue from the *obex* area was prepared for ELISA to detect PrP^{Sc} (Platelia® BSE ELISA, Bio-Rad, from June 2nd TeSeE®, Bio-Rad) as described by the manufacturer.

Table 2. Examination for BSE of cattle sampled in the Norwegian surveillance programme according to categories in 2003

Reason for submission to the laboratory	No. of samples	No. of rejected samples	Negative	Positive
Clinically suspect animals	2	0	2	0
Fallen stock	1,936	64	1,872	0
Emergency slaughter	7,334	12	7,322	0
Ante-mortem animals*	4,107	5	4,102	0
Imported animals	39	0	39	0
Healthy slaughtered animals	10,727	1	10,726	0
Total	**24,145**	**82**	**24,063**	**0**

* Abnormal findings at ante-mortem examination, rejected for human consumption, or which died at the abattoir or during transport.

Risk population and routine slaughtered animals

Unfixed brain tissue from the *obex* area was prepared for ELISA to detect PrP^{Sc} (Platelia® BSE ELISA, Bio-Rad from June 2nd TeSeE®, Bio-Rad) as described by the manufacturer. In cases with positive or inconclusive test results, the remaining half *obex* will be fixed in 10% neutral buffered formalin, embedded in paraffin, sectioned at 5 µm, and stained with HE. Subsequently, the specimen will be processed for immunohistochemical detection of PrP^{Sc} using the same protocol as for specimens from clinical suspects.

Brain samples were rejected for examination if the specimen was autolytic, the dorsal part of the *obex* area was cut obliquely, the *obex* was not present, or the medullar anatomy was not recognisable.

Results and discussion

The National Veterinary Institute received samples from 24,145 cattle. Of these, 82 (0.3%) samples were unsuitable for examination. The categories and number of animals examined are presented in Table 2.

For 2.8% of the samples the herd of origin was not reported, but in case of a positive test result, the herd identity can be traced via the carcass-number. The remaining 23,401 samples originated in 12,718 herds (9,969 dairy cattle herds and 2,749 beef cattle herds). The mean number of examined animals per herd was 1.9.

Clinically suspect animals (passive surveillance)

Only two animals have been investigated as clinical suspects. It is likely that animals with diseases related to the central nervous system have been examined either as fallen stock or emergency slaughtered animals, and thus included in these categories.

Surveillance of slaughtered animals and fallen stock (active surveillance)

The number of cattle examined in each of the categories corresponds well with the numbers examined for 2002 (Table 1). The Norwegian cattle population counts 405,000 cattle older than 24 months (Husdyrregistret per 31.12.03). The number of fallen stock older than 24 months, is about 3,140 (0.77% mortality), (Husdyrregisteret per 31.12.03). The majority of the 1,936 samples from fallen stock was collected on the farms. The difference between the examined number and the number of fallen stock may partly be explained by the fact that many cattle herds are located in remote areas where sampling is time consuming and cumbersome. In addition a proportion of the cattle grasses on mountain and forest pastures where sampling of dead animals is difficult. Furthermore, one reason may be the lack of information to the farmers about their duty to report all cases of fallen stock older than 24 months to the District Veterinary Officers.

The number of samples examined in each region is compared to the expected number of samples (estimated according to the total number of fallen stock older than 24 months and the cattle population in the regions). In most regions the number of animals sampled was low compared to the expected number to be sampled (Figure 1). In contrast, in the region Buskerud, Vestfold and Telemark, a region with a small cattle population, the number sampled and the expected number correspond well. In the region Rogaland and Agder, a region with a large cattle population, there was a minor difference between the numbers sampled ant the expected number. In this region a proportion of the samples are collected at a rendering plant, which make the collecting of samples less cumbersome.

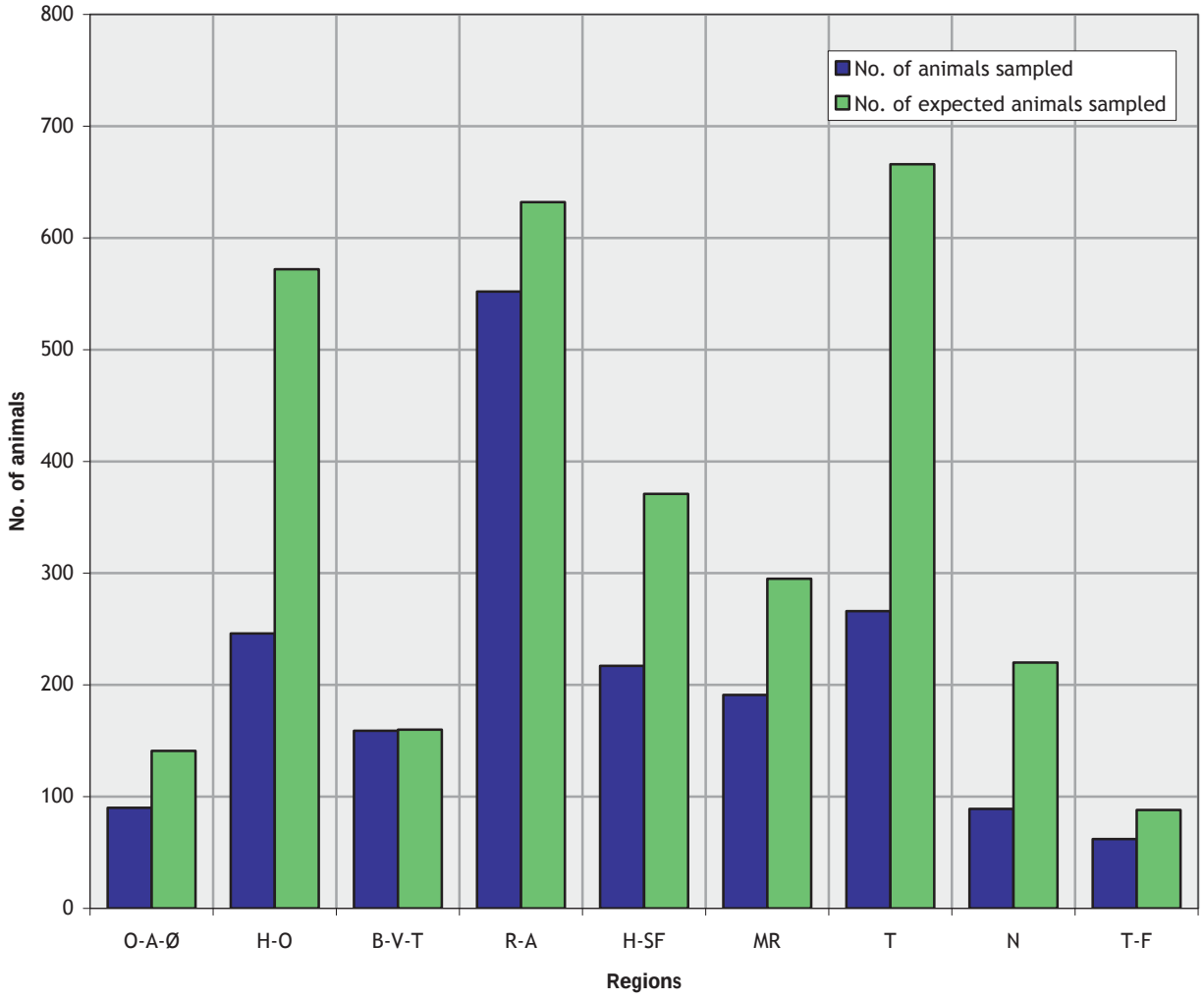


Figure 1. Number (with reported identity) of fallen stock sampled in each surveillance region in 2003, compared with expected numbers (estimated on the basis of the total number of fallen stock older than 24 months and the number of cattle in each region, source: Husdyrregistret per 31.12.03, Statistics Norway per 1.01.04).

Region abbreviations: O-A-Ø = Oslo, Akershus and Østfold, H-O = Hedmark and Oppland, B-V-T = Buskerud, Vestfold and Telemark, R-A = Rogaland and Agder, H-SF = Hordaland and Sogn og Fjordane, MR = Møre og Romsdal, T = Trøndelag, N = Nordland, T-F = Troms and Finnmark.

The mean age at culling of Norwegian cows is low, approximately 50 months for dairy cows and 68 months for suckling cows (suckling cows constitute only 13% of the cattle population older than 24 months) (National Production Recording Scheme 2000, Norwegian Beef Herd recording System 1999). The low age at culling leads to that 39.3% of the samples from dairy cattle and 34.3% of the samples from beef cattle in the fallen stock population originated from cattle younger than 4 years. The age distribution of cattle sampled as fallen stock is shown in Figure 2.

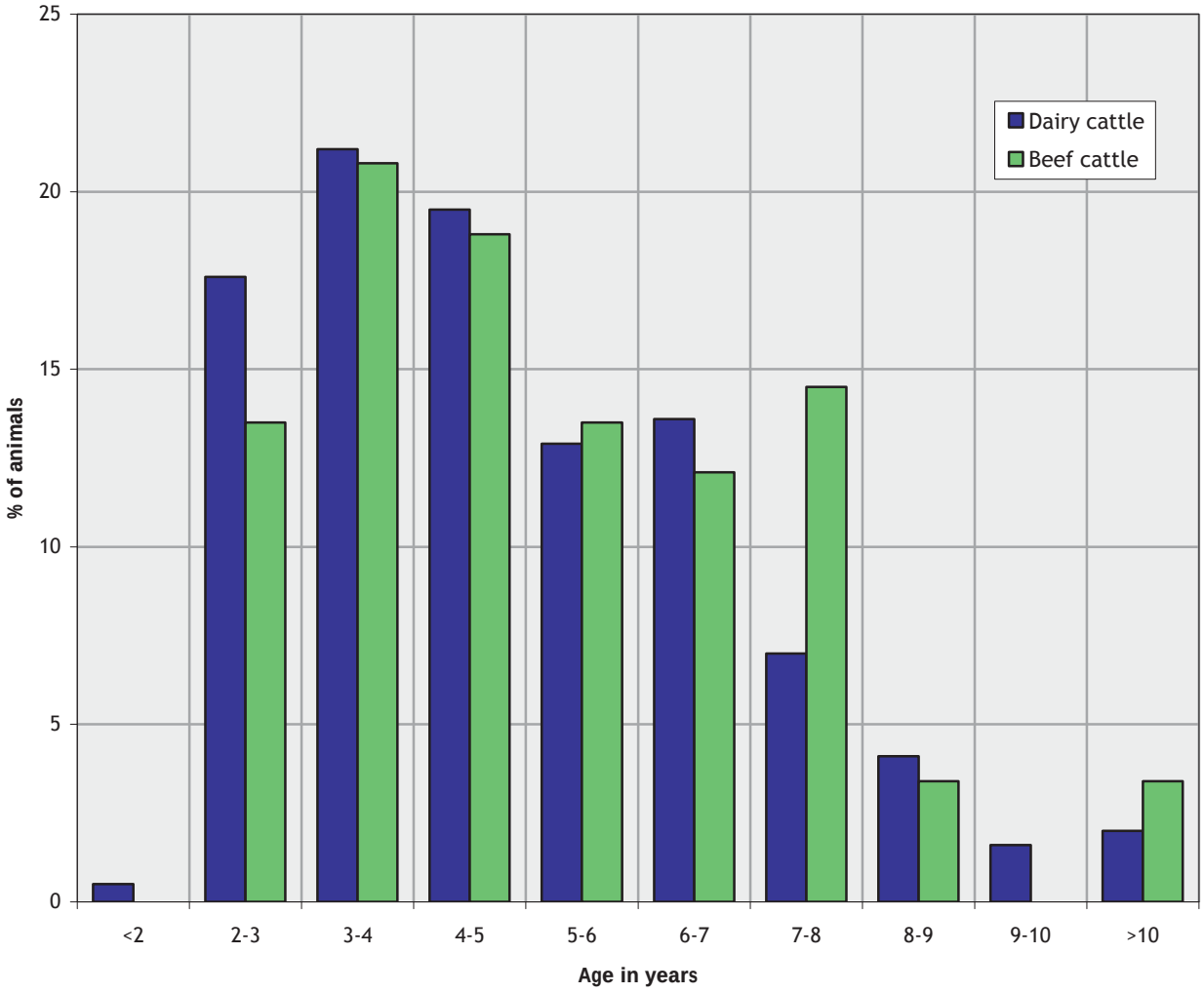


Figure 2. Age distribution of dairy cattle (n=641) and beef cattle (n=207) sampled as fallen stock in 2003 (only animals with confirmed age information are included).

Conclusion

In the BSE-monitoring programme in EU 2002 only 14 (0.65%) of 2,126 verified cases of BSE were younger than 48 months, and 0.04 positive cases were detected per 10,000 tests in cattle 43-48 months, in contrast to 10.84 in cattle 85-90 months (3). These results indicate that BSE-monitoring of animals younger than 48 months is of low value.

The geographical distribution of the cattle population and the animals tested are presented in Figure 3. The figure indicates that there is a variation in the following up of the BSE-surveillance programme also on a municipality level.

The "Surveillance and control programme for bovine spongiform encephalopathy (BSE) in Norway, Report 2001"(4) suggested that the Norwegian cattle population has not been infected by BSE due to: few imports to Norway of cattle and products potentially infected with the BSE agent, limited use of meat and bone meal in concentrates intended for ruminants, and the use of high temperature and pressure in the domestic production of meat and bone meal. The compiled results from the Surveillance and control programme for BSE in 2001, 2002 (5) and 2003 with 60,000 negative samples, strengthen the assumption that Norwegian cattle are not infected with the BSE-agent.

Acknowledgements

We thank the District Veterinary Officers and the Veterinary Officers at the Municipal Food Control Authorities for the collection of samples for BSE-examination.

References

1. Anonymous, 1996. Scrapie I. In: Manual of standards for diagnostic tests and vaccines. 3rd ed. Office International des Epizooties, Paris, France, pp. 673-677.

2. Anonymous, 2000. Scrapie I. In: Manual of standards for diagnostic tests and vaccines. List A and list B diseases for mammals, birds and bees. 4th ed. Office International des Epizooties, Paris, pp. 873-880.

3. Anonymous, 2003. Report on the monitoring and testing of ruminants for the presence of transmissible spongiform encephalopathy (TSE) in 2002. European Commission, Health & Consumer Protection Directorate-General, Brussel, Belgium, 69 pp.

4. Mørk, T., Bratberg, B., Hopp, P., Benestad, S.L., Høgåsen, H., Bruheim, T., 2002. The surveillance and control programme for bovine spongiform encephalopathy (BSE) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 55-66.

5. Valheim, M., Bratberg, B., Høgåsen, H., Moldal, T., 2003. The surveillance and control programme for bovine spongiform encephalopathy (BSE) in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 49-56.

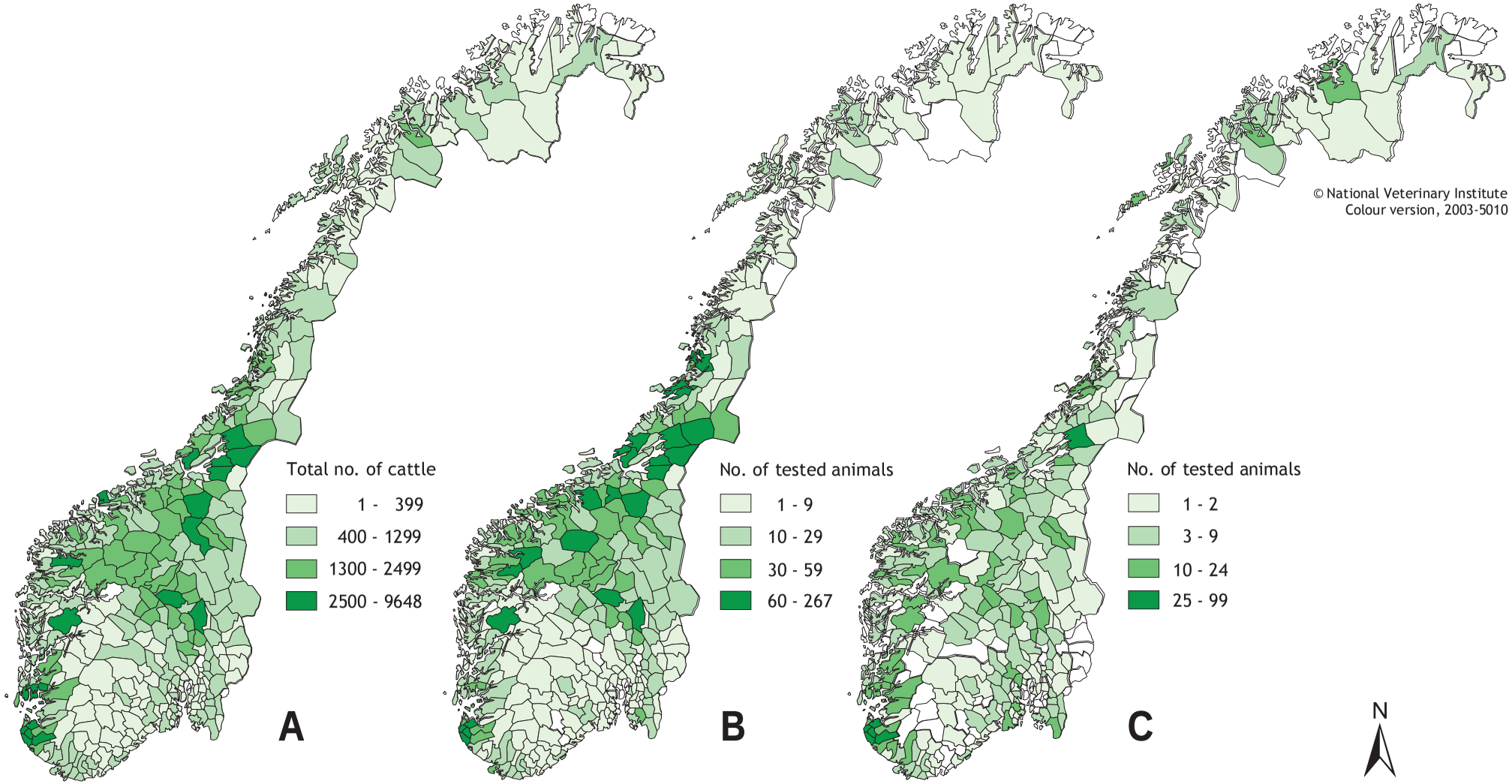


Figure 3. Geographical distribution on municipality level of the cattle population (cattle > 2 year) (A), number of emergency slaughtered animals tested (B) and number of fallen stock tested (C) in the Surveillance and control programme for BSE in 2003.

The surveillance and control programme for infectious bovine rhinotracheitis (IBR) and infectious pustular vulvovaginitis (IPV) in Norway

Annual report 2003

Ola Nyberg
Jorun Tharaldsen
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

In the early 1960s two outbreaks of infectious pustular vulvovaginitis were diagnosed in cattle in Norway. Since then, no cases of infectious bovine rhinotracheitis/ infectious pustular vulvovaginitis (IBR/IPV) were reported until 1993, when several animals in one single herd were found to be serologically positive after primary testing of bulk milk collected in 1992. Clinical signs of IBR/IPV were never recorded on the farm. All animals on the farm were slaughtered. Virus isolation attempts from organ samples gave negative results. Sixteen contact herds and all dairy herds in the same region were serologically negative (1, 4, 5). Likewise 40 red deer, which were shot in the neighbourhood during the hunting season the same year, were also serologically negative (unpublished). IBR/IPV virus infection has not been demonstrated since then in Norway. All breeding bull candidates are tested serologically in quarantine before entering the breeding centres. All breeding bulls are subject to a compulsory test each year.

The Norwegian Animal Health Authority is responsible for carrying out the IBR/IPV surveillance and control programme. The National Veterinary Institute is in charge of planning the programme, collecting the bulk milk samples from the dairies and performing the tests. The District Veterinary Officers collect the blood samples from the beef herds.

Aim

EFTA Surveillance Authority (ESA) has recognised Norway as free from IBR since 1994. Decisions concerning the additional guarantees relating to IBR for bovines destined to Norway are described in ESA Decision 74/94/COL, amending ESA Decision 20/94/COL.

The ESA Decisions accepting Norway's free status of IBR include requirements on annual reports of the surveillance of the disease.

Material and methods

The surveillance of cattle included both dairy and beef herds. Bulk milk samples from the dairy herds were collected at the dairies. From the beef herds, individual blood samples were collected on the farms from cattle older than 24 months.

The total group of dairy herds from which the selection of herds were made, consisted of all herds of cattle delivering milk to the dairies in the sampling period. In 2003, bulk milk samples from 1,845 randomly sampled dairy herds were tested. The group of beef herds to be sampled was based on a register of all beef herds receiving governmental support according to recordings of July 2002. A total of 3,901 individual blood samples from 449 beef herds were analysed in pools with a maximum of 20 samples in each. The sampled herds represented approximately 10.6% of the Norwegian cattle herds.

The number of herds in the monitoring programme for IBR/IPV in 2003 is given in Table 1. The geographic distribution of the total number and the tested number of dairy and beef herds are shown in Figures 1 and 2.

All 1,845 bulk milk samples and 3,901 blood samples were tested for antibodies against bovine herpes virus 1 (BHV-1) using a blocking-ELISA (2) at the National Veterinary Institute, Oslo.

Table 1. Total number of dairy herds and beef herds within the frame of the Norwegian monitoring programme for IBR/IPV in 2003

Herd category	Total no. of cattle herds*	No. of herds tested	% tested of the total no. of herds
Dairy herds	17,447	1,845	10.6
Beef herds	4,132	449	10.9
Total	**21,579**	**2,294**	**10.6**

* Based on data from the Register of production subsidies as of 31 July 2002.

Results

All the samples tested for antibodies against BHV-1 in 2003 were negative. Table 2 shows the results of the testing during the period from 1993 to 2003.

Table 2. Antibodies against IBR/IPV virus in the Norwegian bovine population during the time period 1993-2003

	Dairy herds	Beef herds		
Year	No. of bulk milk samples tested	No. of beef herds sampled	No. of individuals tested	No. of positive samples
1993	26,642	0	0	1
1994	24,832	1,430	5,954	0
1995	25,131	1,532	9,354	0
1996	2,863	303	1,523	0
1997	2,654	2,214	16,741	0
1998	2,816	2,191	17,095	0
1999	2,930	2,382	18,274	0
2000	1,590	340	2,892	0
2001	2,564	434	3,453	0
2002	2,308	462	3,693	0
2003	1,845	449	3,901	0

Discussion

Norway has had additional guarantees from ESA since 1994. Such guarantees depend on a continuous surveillance of the Norwegian cattle population based on serological examination. The surveillance and control programme has been evaluated using Monte Carlo simulation models (3). The Danish ELISA-test is calculated to have a sensitivity of 82.9% when used for bulk milk testing in Denmark (2), but the sensitivity improves when the same test is used in Norway because of the smaller herds. The number of milking cows in an average Norwegian herd is 15, compared to more than 55 in Denmark. The sensitivity is even better when testing serum samples and Norwegian investigations have shown that the test has a specificity of 100% (3).

The results of the continuous testing since 1992/93 strongly indicate that the Norwegian cattle population is free from IBR/IPV-infection, and that the programme, combined with the additional guarantees and the testing procedures for imported cattle, are adequate means to discover new introduction of infection.

References

1. Tharaldsen, J., Krogsrud, J. and Ødegaard, Ø. 1993. Påvist besetningsinfeksjon med bovint herpesvirus 1 (BHV-1). Nor. Vet. Tidskr. 105, 363-364.

2. Nylin, B., Strøger, U., Rønsholt, L., 2000. A retrospective evaluation of a bovine herpes virus-1 (BHV-1) antibody ELISA on bulk-tank milk samples for classification of the BHV-1status of Danish dairy herds. Prev. Vet. Med. 47, 91-105.

3. Paisley, L.G., Tharaldsen, J., Jarp, J., 2001. A retrospective analysis of the infectious rhinotracheitis (bovine herpes virus-1) surveillance program using Monte Carlo simulation models. Prev. Vet. Med. 50, 109-125.

4. Nyberg, O., Jarp, J., Tharaldsen, J., 2002. The surveillance and control programme for infectious bovine rhinotracheitis (IBR)/infectious pustular vulvovaginitis (IPV) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 67-73.

5. Nyberg, O., Tharaldsen, J., 2003. The surveillance and control programme for infectious bovine rhinotraceitis (IBR) and infectious pustular vulvovaginitis (IPV) in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 57-63.

Introduction

In the early 1960s two outbreaks of infectious pustular vulvovaginitis were diagnosed in cattle in Norway. Since then, no cases of infectious bovine rhinotracheitis/ infectious pustular vulvovaginitis (IBR/IPV) were reported until 1993, when several animals in one single herd were found to be serologically positive after primary testing of bulk milk collected in 1992. Clinical signs of IBR/IPV were never recorded on the farm. All animals on the farm were slaughtered. Virus isolation attempts from organ samples gave negative results. Sixteen contact herds and all dairy herds in the same region were serologically negative (1, 4, 5). Likewise 40 red deer, which were shot in the neighbourhood during the hunting season the same year, were also serologically negative (unpublished). IBR/IPV virus infection has not been demonstrated since then in Norway. All breeding bull candidates are tested serologically in quarantine before entering the breeding centres. All breeding bulls are subject to a compulsory test each year.

The Norwegian Animal Health Authority is responsible for carrying out the IBR/IPV surveillance and control programme. The National Veterinary Institute is in charge of planning the programme, collecting the bulk milk samples from the dairies and performing the tests. The District Veterinary Officers collect the blood samples from the beef herds.

Aim

EFTA Surveillance Authority (ESA) has recognised Norway as free from IBR since 1994. Decisions concerning the additional guarantees relating to IBR for bovines destined to Norway are described in ESA Decision 74/94/COL, amending ESA Decision 20/94/COL.

The ESA Decisions accepting Norway's free status of IBR include requirements on annual reports of the surveillance of the disease.

Material and methods

The surveillance of cattle included both dairy and beef herds. Bulk milk samples from the dairy herds were collected at the dairies. From the beef herds, individual blood samples were collected on the farms from cattle older than 24 months.

The total group of dairy herds from which the selection of herds were made, consisted of all herds of cattle delivering milk to the dairies in the sampling period. In 2003, bulk milk samples from 1,845 randomly sampled dairy herds were tested. The group of beef herds to be sampled was based on a register of all beef herds receiving governmental support according to recordings of July 2002. A total of 3,901 individual blood samples from 449 beef herds were analysed in pools with a maximum of 20 samples in each. The sampled herds represented approximately 10.6% of the Norwegian cattle herds.

The number of herds in the monitoring programme for IBR/IPV in 2003 is given in Table 1. The geographic distribution of the total number and the tested number of dairy and beef herds are shown in Figures 1 and 2.

All 1,845 bulk milk samples and 3,901 blood samples were tested for antibodies against bovine herpes virus 1 (BHV-1) using a blocking-ELISA (2) at the National Veterinary Institute, Oslo.

Table 1. Total number of dairy herds and beef herds within the frame of the Norwegian monitoring programme for IBR/IPV in 2003

Herd category	Total no. of cattle herds*	No. of herds tested	% tested of the total no. of herds
Dairy herds	17,447	1,845	10.6
Beef herds	4,132	449	10.9
Total	**21,579**	**2,294**	**10.6**

* Based on data from the Register of production subsidies as of 31 July 2002.

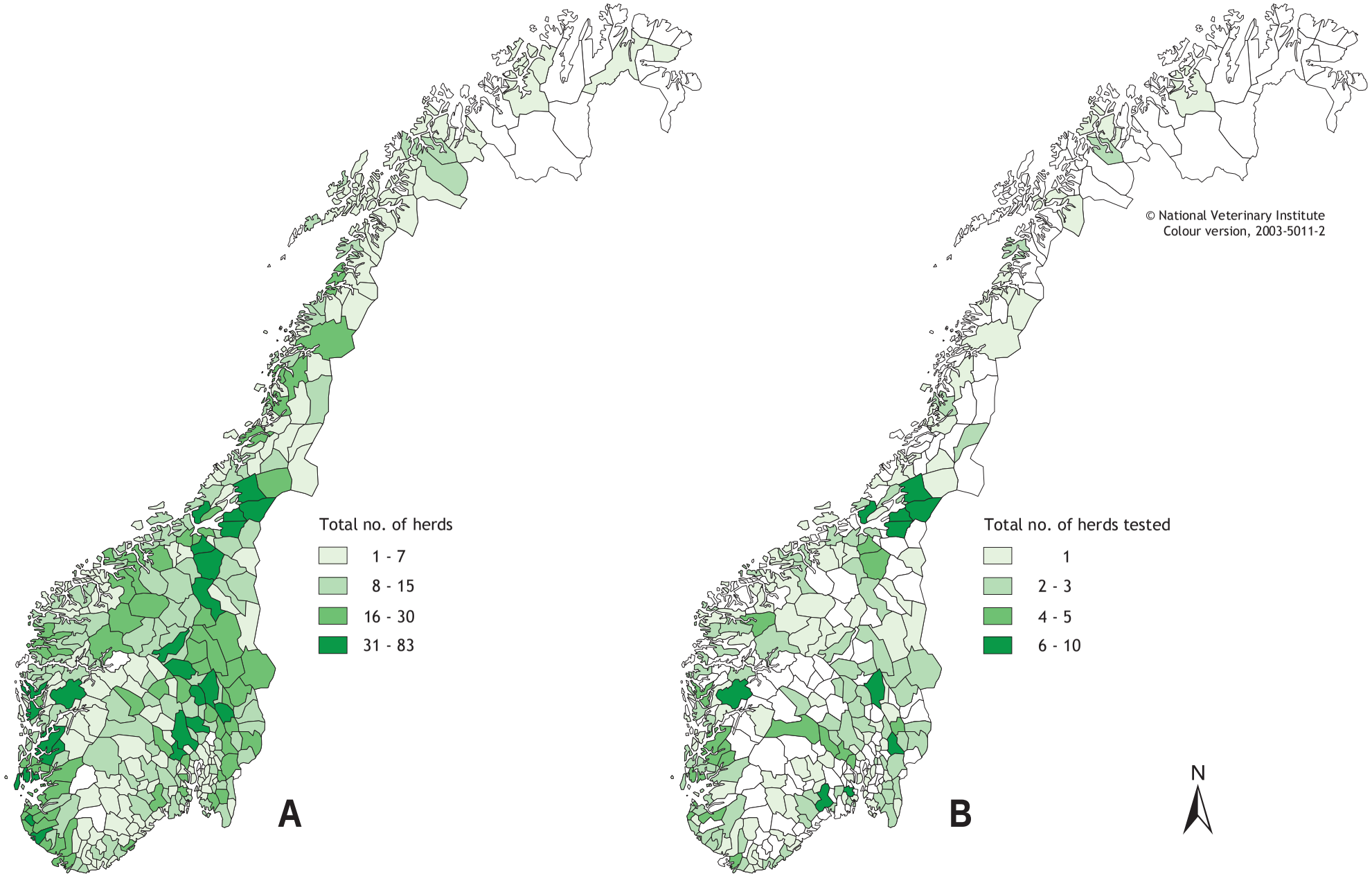


Figure 2. Geographical distribution on municipality level of the beef herd population (A), and of the beef herds tested in the surveillance and control programme for IBR/IPV (B) in 2003.

The surveillance and control programme for enzootic bovine leukosis (EBL) in Norway

Annual report 2003

Ola Nyberg
Jorun Tharaldsen
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

Enzootic bovine leukosis (EBL) had never been reported in Norway, neither clinically nor serologically, until the start of this surveillance and control programme in 1995. In 1976-77, blood samples from 3,885 cattle were examined with both haematological methods, and with serological methods for antibodies against bovine leukaemia virus (BLV) (1). In 1991, 1,575 bulk milk samples were tested with an ELISA-test with no positive findings. From 1979, approximately 290 young bulls entering the breeding centres have been tested annually, first by an immunodiffusion test and from 1990 by an ELISA-test.

The Norwegian Animal Health Authority is responsible for carrying out the EBL surveillance and control programme. The National Veterinary Institute is in charge of planning the programme, collecting the bulk milk samples from the dairies, and performing the tests. The District Veterinary Officers collect the blood samples from the beef herds.

From the material collected in 1994-95, antibodies against BLV were detected in eight dairy herds. In 1996, one dairy herd was found (2) (Figure 1A). Restrictions were immediately imposed on positive herds and control measures included culling of antibody positive reagents. All the animals were retested over the next years. In one herd, all the animals were culled because more than 80% of adult animals were positive.

Aim

The intention of the EBL surveillance and control programme is to document the freedom from this infection in Norway. Further, the intention is to apply for EBL free status according to the EEC-agreement (Council Directive 64/432/EEC of 26.06.64 as amended by Council Directives 97/12 of 17.03.97 and 98/46 of 24.06.98).

Materials and methods

The surveillance programme included both dairy and beef herds. Bulk milk samples from the dairy herds were collected from the dairies. From the beef herds, individual blood samples were collected on the farms from cattle older than 24 months.

The group of dairy herds sampled was selected from all herds of cattle delivering milk to the dairies during the sampling period. In 2003, bulk milk samples from 1,845 randomly sampled dairy herds were tested. The group of beef herds to be sampled was based on a register of all beef herds receiving governmental support according to recordings of July 2002. A total of 3,901 individual blood samples from 449 beef herds were analysed in pools, with a maximum of 20 samples in each. The sampled herds represented approximately 10.6% of the Norwegian cattle herds.

The number of herds in the monitoring programme for EBL in 2003 is given in Table 2. The geographic distribution of the total number of herds and the tested number of dairy and beef herds are given in Figure 1B and Figure 2A and 2B.

Bulk milk samples and blood samples (pooled serum from a maximum of 20 samples) were examined by an indirect ELISA (SVANOVA®) (3). For verification and for follow up of suspect cases, LACTELISA BLV Ab and SERELISA BLV Ab from SYNBIOTICS were used.

Results

A historic survey of the surveillance of BLV-antibodies in the Norwegian population is given in Table 1, and the location of the antibody-positive herds found in 1995-96 is shown in Figure 1A.
Bulk milk samples from 1,845 dairy herds and 3,901 individual blood samples from 449 beef herds were tested for antibodies against BLV in 2003 (Table 2).

Table 1. Antibodies against BLV in the Norwegian bovine population during the time period 1995-2003

	Dairy herds	Beef herds		
Year	No. of bulk milk samples analysed	No. of beef herds sampled	No. of individuals analysed	No. of positive samples
1995	25,131	1,532	9,354	8 (bulk milk)
1996	25,278	303	1,523	1 (bulk milk)
1997	26,903	2,214	16,741	0
1998	23,581	2,191	17,095	0
1999	19,933	2,382	18,274	0
2000	1,590	340	2,892	0
2001	2,564	434	3,453	0
2002	2,308	462	3,693	1 (bulk milk)
2003	1,845	449	3,901	0

All bulk milk samples and blood samples tested for antibodies against EBLV in 2003 were negative.

Table 2. Total number of dairy herds and beef herds within the frame of the Norwegian monitoring programme for EBL in 2003

Herd category	Total no. of cattle herds*	No. of herds tested	% tested of the total no. of herds
Dairy herds	17,447	1,845	10.6
Beef herds	4,132	449	10.9
Total	**21,579**	**2,294**	**10.6**

* Based on data from the Register of production subsidies as of 31 July 2002.

Discussion

The requirement from the EU for granting an EBL free-status is that the prevalence must be lower than 0.2%, which represents 43 herds out of a total number of 21,579 herds. EBL had never been reported until the surveillance and control programme detected nine positive herds in 1995-96. These herds are now free of EBL, and no new herds tested positive during the period 1997-2001. From year 2000, only 10% of the herds are examined annually.

In 2002, one bulk milk sample from a dairy herd gave a positive result for antibodies against BLV (Figure 1A). It was a small herd consisting of only nine dairy cows. Further investigations showed that only one cow was antibody positive. The cow was healthy and had no clinical symptoms, she was slaughtered, and the pathological investigations gave no indication of leukosis. Further testing of individual blood samples of all cattle older than 24 months in the herd and six contact herds was negative. The conclusion is that the positive antibody test probably was due to a false positive serological reaction. The follow up study was terminated in 2003 with no positive findings (5).

The results of the continuous surveillance since 1995 indicate that the Norwegian cattle population is free from EBL according to the EU requirements. Together with the possible isolation period of six months and the testing protocol for imported animals, this programme should be sufficient to discover introduction of new infection.

References

1. Norberg, H.S., 1978. Bovin leukose. Oversikt og redegjørelse for norske undersøkelser. (Bovine leukosis. Review of Norwegian investigations). Nor. Vet. Tidsskr. 90, 533-541.

2. Tharaldsen, J., Ødegaard, Ø., Krogsrud, J., 1996. Smittsom storfeleukose diagnostisert i Norge. (Contagious bovine leukosis diagnosed in Norway). Nor. Vet. Tidsskr. 108, 550.

3. Klintevall, K., Näslund, K., Svedlund, G., Hajdu, L., Linde, N., Klingeborn, B., 1991. Evaluation of an indirect ELISA for the detection of antibodies to bovine leukemia virus in milk and serum. J. Vir. Method. 33, 319-333.

4. Nyberg, O., Jarp, J., Tharaldsen, J., 2002. The surveillance and control programme for enzootic bovine leucosis (EBL) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 75-81.

5. Nyberg, O., Tharaldsen, J., 2003. The surveillance and control programme for enzootic bovine leucosis (EBL) in Norway. In: Heier, B.T., (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp 65-71.

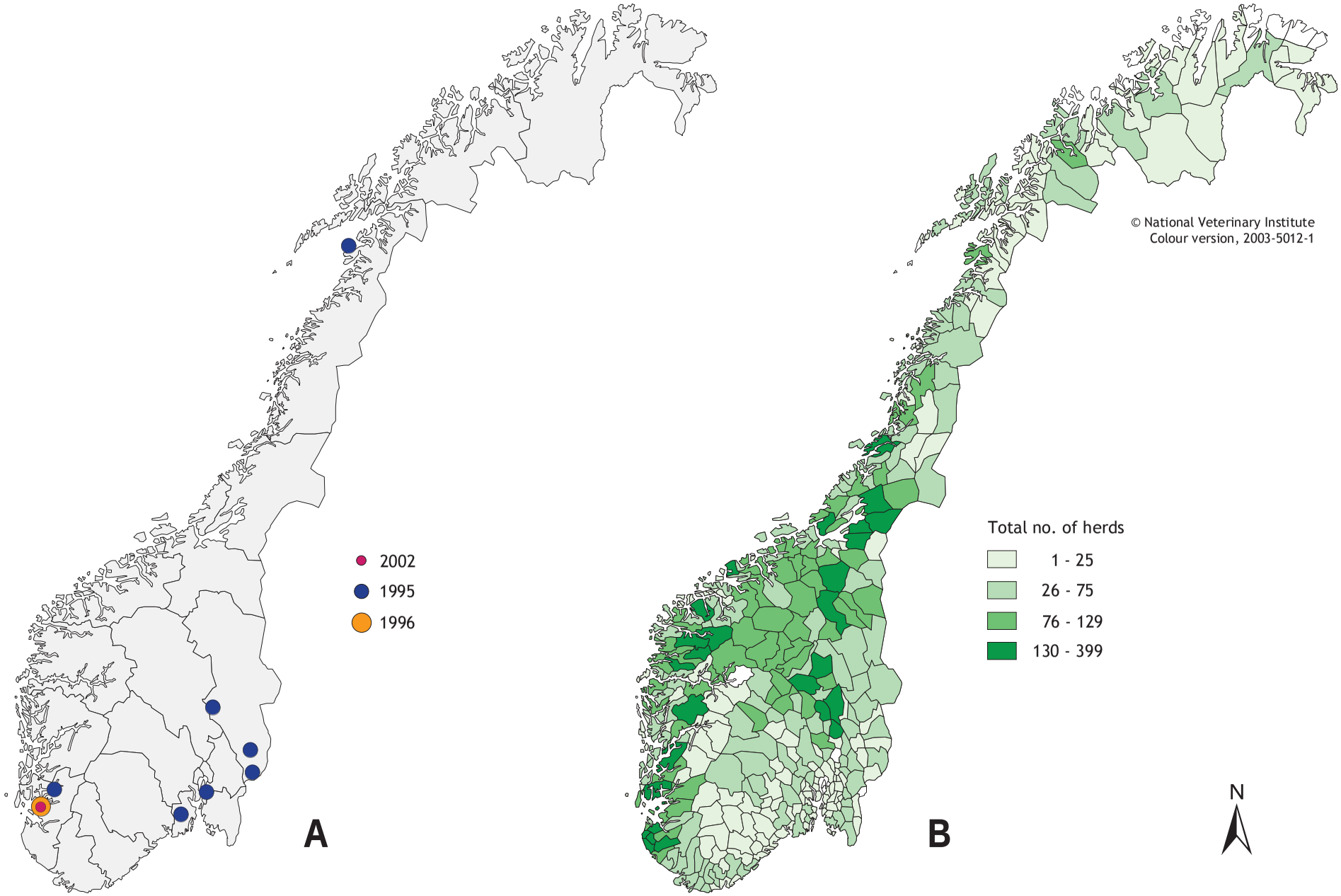


Figure 1. Geographical location of cattle herds in which anti bodies against the EBL-virus have been found (A), and the geographical distribution on municipality level of all cattle herds (B) in 2003.

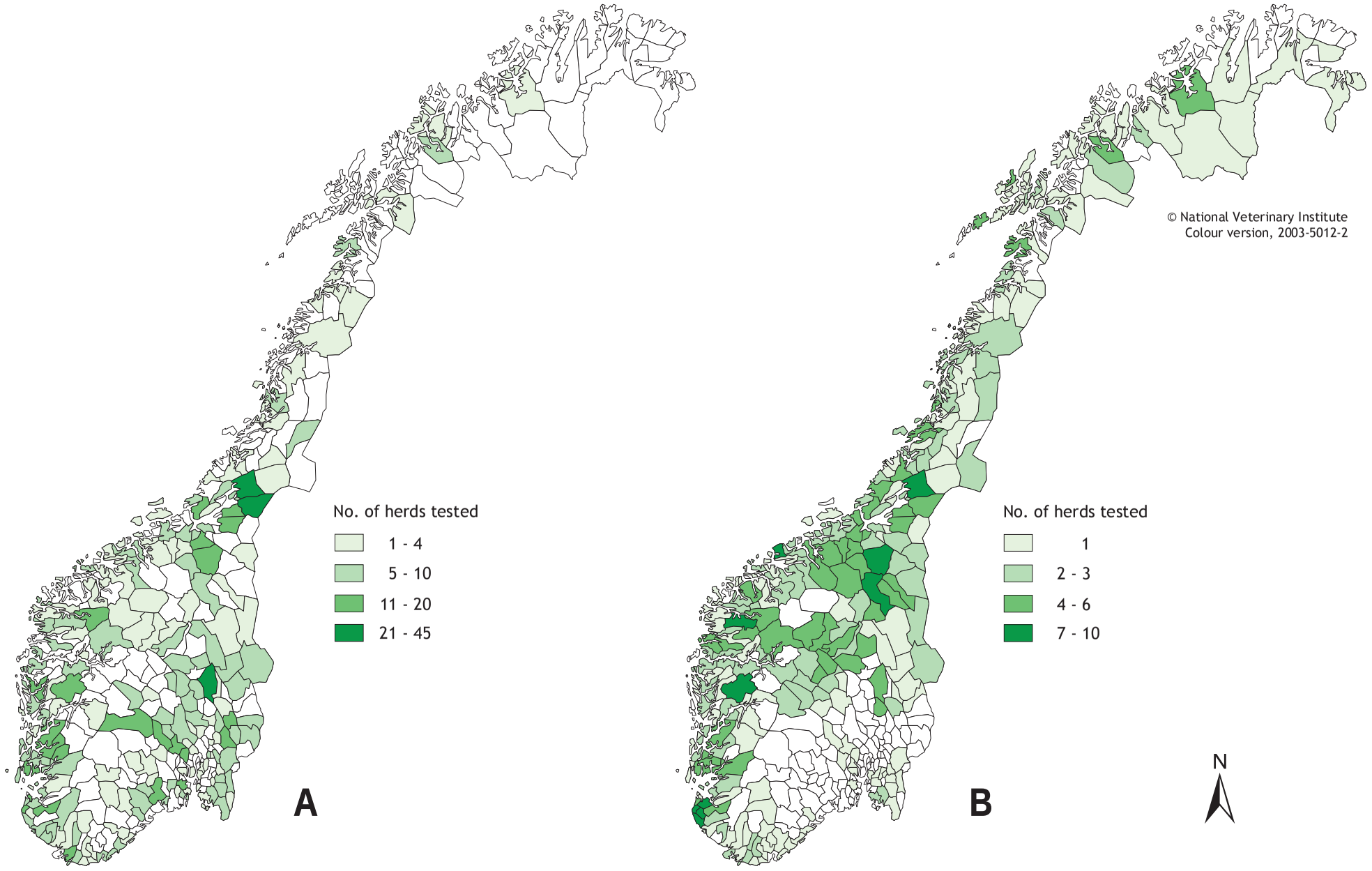


Figure 2. Geographical distribution on municipality level of the dairy herds (A), and the beef herds (B) tested in the surveillance and control programme for EBL in 2003.

The surveillance and control programme for bovine brucellosis in Norway

Annual report 2003

Ola Nyberg
Jorun Tharaldsen
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

Eradication of bovine brucellosis in Norway was achieved in 1950 (1). Since 1994, EFTA Surveillance Authority (ESA) has recognised Norway as an "officially brucellosis free state" as described in ESA Decision 66/94/COL. In 2000, the Animal Health Authority launched a surveillance and control programme on bovine brucellosis in which milk, blood and foetuses from dairy and beef herds were examined for evidence of *Brucella abortus* infection (Table 1). All investigations on *Brucella abortus* were negative in 2000 and 2001 (1). In 2002, two bulk milk samples were antibody positive. Blood samples from animals older than two years were collected from these herds. Two cows in one farm and one cow in the other farm were positive in three different tests in two consecutive samplings six weeks apart. All three cows were culled. Autopsy did not indicate brucellosis, and bacterial examination was negative for *Brucella abortus.* Serological examinations of the animals in both herds 30 and 90 days after culling were negative. It was concluded that the positive serological results probably were false positive reactions, most likely because of cross reactions (2).

Aim

The purpose of the programme is to document freedom from bovine brucellosis according to demands in Directive 64/432/EEC with amendments and contribute to the maintenance of this favourable situation. The Animal Health Authority has implemented the programme while the National Veterinary Institute is responsible for planning, laboratory analyses and reporting.

Material and methods

Active surveillance

Sampling of herds

Dairy herds are selected from the total number of herds delivering milk to dairies during the sampling period, while beef herds are selected from all beef herds receiving subsidies the year before (2002). During 2003, 21.1% of the dairy herds and 21.5% of the beef herds were sampled (Table 2). The geographic distribution is given in Figure 1 and Figure 2.

Bulk-milk samples from the dairy herds are collected at the dairies, while individual blood samples are taken from all cattle older than 24 months in beef herds.

Table 1. Number of bulk milk samples, blood samples and foetuses examined for brucellosis in the Norwegian cattle population in 2000, 2001 and 2002

		Dairy cattle		Beef cattle		Total	
Year	**Material**	Samples	Herds	Samples	Herds	Samples	Herds
2000	Bulk milk/blood	4,228	4,228	5,695	677	9,923	4,905
	Foetuses	17	14	0	0	17	14
2001	Bulk milk/blood	5,128	5,128	7,027	868	12,155	5,996
	Foetuses	21	18	0	0	21	18
2002	Bulk milk/blood	4,664	4,664	7,296	915	11,960	5,579
	Foetuses	18	17	10	6	28	23

Table 2. Total number of dairy herds and beef herds within the Norwegian monitoring programme for bovine brucellosis in 2003

Herd category	Total no. of herds*	No. of herds tested	% tested of the total no. of herds
Dairy herds	17,447	3,684	21.1
Beef herds	4,132	887	21.5
Total	**21,579**	**4,571**	**21.2**

* Based on data from the Register of production subsidies as of 31 July 2002.

Passive clinical surveillance

Herd criteria for submission of clinical material are;

- abortions occurring between the fifth month of pregnancy and 14 days before expected birth
- at least two abortions within this pregnancy period the last 12 months

Material for submission;

- foetus and the foetal membranes
- blood sample from the cow at the time of abortion and a second blood sample collected 14-21 days later

Foetuses, foetal membranes and blood samples are collected by the District Veterinary Officers and submitted to the National Veterinary Institute, Oslo.

Serology

All bulk milk samples and individual blood samples are tested for antibodies against *Brucella abortus* in an indirect ELISA (Svanova®). In the bulk milk testing, the volume of milk is 100 µl per well, and in the blood sample testing, 4 µl per well. The initial screening is performed using a single well per sample and doubtful or positive reactions were retested in duplicates. If the result is negative when retested, the sample is concluded to be negative for antibodies against *Brucella abortus.* If the result still is doubtful or positive, the sample is tested with a competitive ELISA (C-ELISA, Svanova®). Positive samples in this test are subjected to a complement fixation test (CF). If the CF test also is positive, the result is reported with recommendation of a new blood sample from the suspected animal four to six weeks after the initial sampling. If this is positive, or if there should be a need for immediate follow up, the animal will be tested with an intracutane test using Brucellergene OCB from *Brucella melitensis* (Synbiotics®).

Post mortem investigations

Foetuses are subjected to a full autopsy. Specimens from lungs, myocardium, liver, kidneys, (whole) brain, and foetal membranes, are fixed in 10% neutral phosphate buffered formalin. The specimens are processed according to a standard routine protocol, sectioned at 5 µm and stained with haematoxylin and eosin (HE).

Bacteriological investigations

Foetal membranes and organs from the aborted foetus (liver, spleen and stomach contents) are sampled. Direct smears from these materials are examined following Gram and Modified Ziehl-Neelsen (MZN) staining. Samples are cultured on bovine blood agar containing 5% bovine blood, Skirrows medium and Tryptone Soy Agar (TSA) at 37°C in a 10% CO_2 atmosphere. The media are examined regularly and incubated for up to 14 days. Suspicious bacterial colonies are tested for motility, nitrate reduction, and for the production of catalase, indol, cytochrome oxidase, and urease. Non-motile, nitrate reducing, indol negative, and catalase, cytochrome oxidase and urease producing isolates are sent to a reference laboratory for further identification.

Results

A total of 3,684 bulk-milk samples from 3,684 dairy herds, 7,905 blood samples from 887 beef herds and 23 individual blood samples related to abortions were analysed (Table 3).

All bulk milk samples and blood samples tested for antibodies against *Brucella abortus* in 2003 were negative.

Post mortem investigations on foetuses in 2003 did not reveal pathological changes indicative of brucellosis. All bacteriological investigations on *Brucella abortus* were negative in 2003.

Discussion

There was no detection of bovine brucellosis in 2003. With the exception of a single relapse in 1953, bovine brucellosis has not been detected in Norway since 1950 (1, 2).

Table 3. Number of bulk milk samples, blood samples and foetuses tested for bovine brucellosis in dairy herds and beef herds in 2003

	Dairy cattle		Beef cattle		Total	
Material	Samples	Herds	Samples	Herds	Samples	Herds
Bulk-milk/blood	3,684	3,684	7,905	887	11,589	4,571
Foetuses	30	24	4	4	34	28
Blood samples related to abortions					23	21

References

1. Mørk, T., Tharaldsen, J., Bratberg, B., Holstad, G., Jarp, J., 2002. The surveillance and control programme for bovine brucellosis in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 75-81.

2. Nyberg, O., Tharaldsen, J., 2003. The Surveillance and control programmes for bovine brucellosis in Norway. In: Heier, B. T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway pp. 73-79.

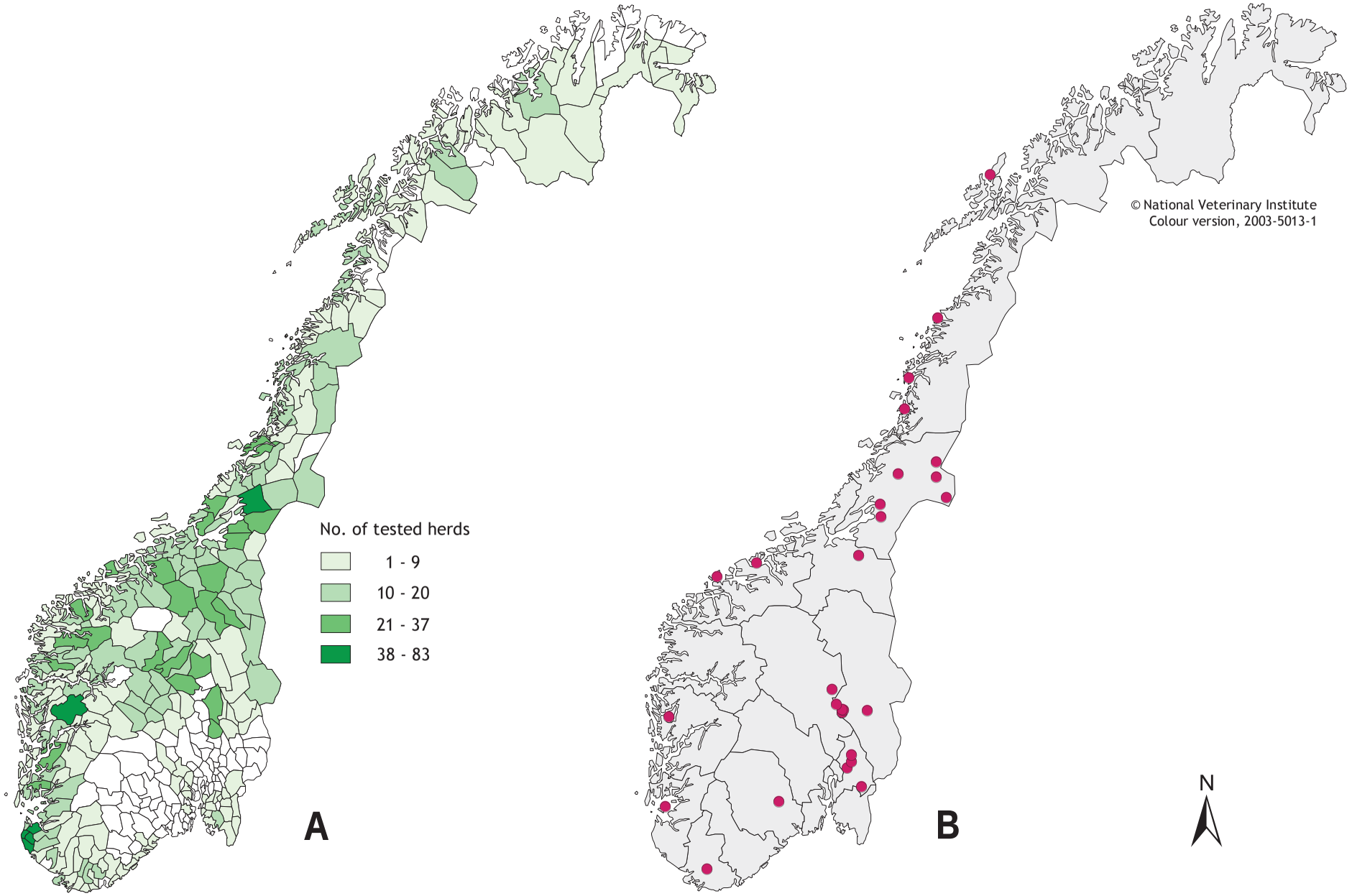


Figure 1. Geographical distribution on municipality level of the dairy herds (A) and the geographical location of farms from which foetuses have been investigated in the surveillance and control programme for bovine brucellosis (B) in 2003.

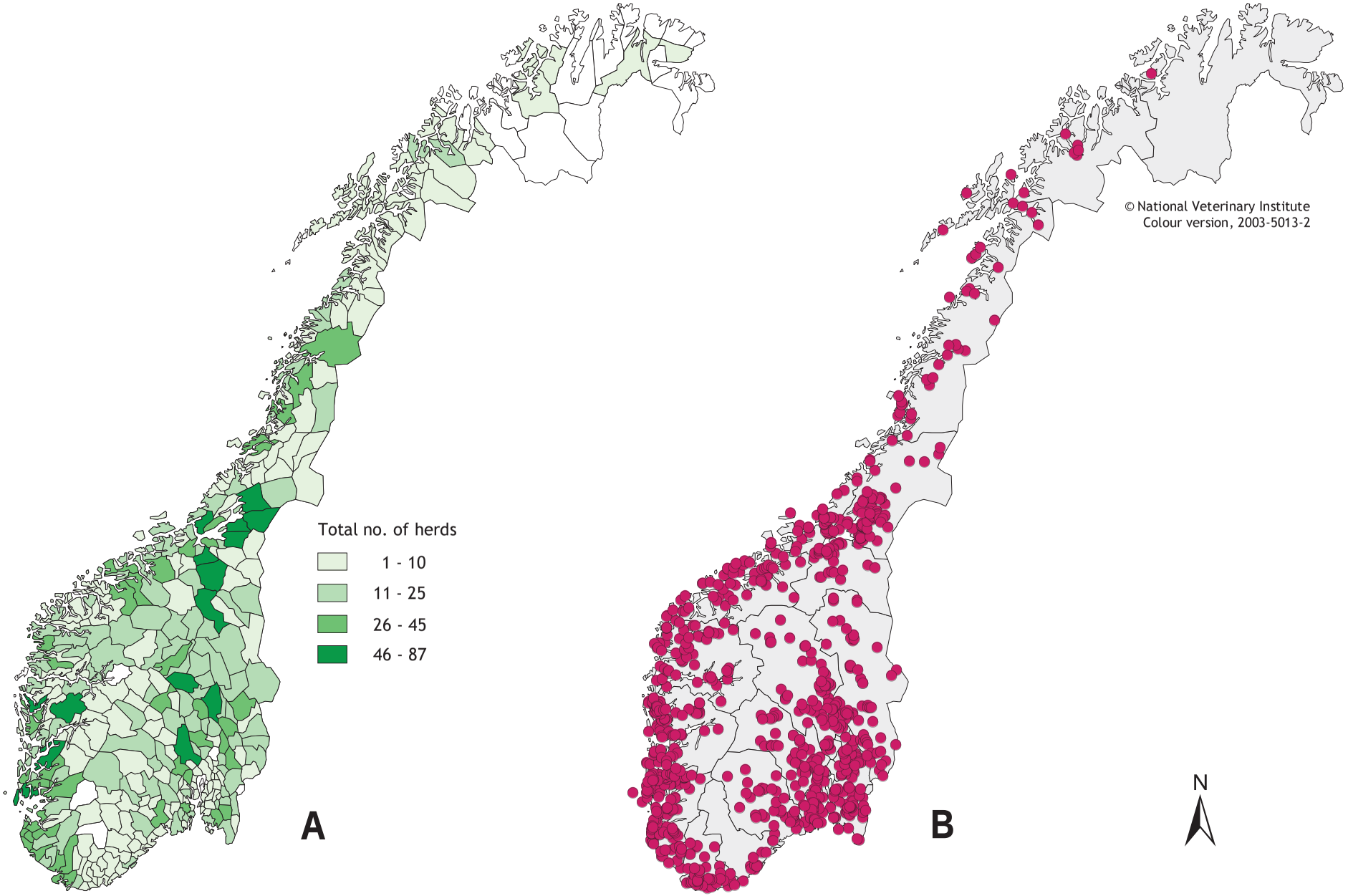


Figure 2. Geographical distribution on municipality level of the unique beef herd population (A) and the geographical location of the beef herds tested in the surveillance and control programme for bovine brucellosis (B) in 2003.

The surveillance and control programme for bovine virus diarrhoea (BVD) in Norway

Annual report 2003

Ola Nyberg
Sveinn Gudmundsson
Johan Åkerstedt

Veterinærinstituttet
National Veterinary Institute

Introduction

Bovine virus diarrhoea (BVD) is a notifiable disease in Norway. From 1984 to 1986, preliminary investigations indicated that nearly 30% of the dairy herds contained animals with antibodies to BVDV (1). The high prevalence and cost of the disease made a surveillance and control programme urgent, and this was started in December 1992. The Animal Health Authority was in charge of the programme and responsible for blood sampling and imposing control measures in positive herds. The National Veterinary Institute performed the laboratory analyses (2, 3). The government and the industry finance the programme.

During the programme period, the number of restricted herds has decreased from 2,950 in 1994 to 3 in 2003 (Figure 1). The progress was considered excellent in the first years, but less so during the later period as demonstrated by the long "tail" (Figure 1). The main reason for this tail is that the number of new infected herds is relatively high (Figure 2). These herds are mostly located in the same areas as the remaining herds with restrictions.

The programme is divided into a three-step operation:
1. Bulk milk from all dairy herds is tested for antibodies, and the herds are classified from 0 to 3 according to the BVDV antibody level (Table 4).
2. In herds with an antibody titre above a certain minimum level, pooled milk from primiparous cows is examined for BVDV antibodies.
3. If the pooled milk in step 2 is antibody-positive, blood samples from three to five approximately one year old animals are collected, and a pooled sample is examined for BVDV antibodies. In beef cattle herds a pooled blood sample (of up to five animals) from young stock is examined.

The testing for antibodies in bulk milk and pooled samples from primiparous cows is usually performed once a year as a minimum, but pooled serum samples are tested more often in many herds. Table 1-3 show the results of the tested herds in the programme during the period 1993-2002.

Table 1. Distribution of Norwegian dairy herds in relation to BVDV antibody level in bulk milk during the period 1993-2002

Year	No. of herds	% of herds in class 0 (S/P ratio<0.05)	% of herds in class 1 (0.05≤S/P ratio<0.25)	% of herds in class 2 (0.25≤S/P ratio<0.55)	% of herds in class 3 (S/P ratio≥0.55)
1993	26,424	63.0	14.1	15.9	7.1
1994	26,148	63.4	12.2	14.5	9.9
1995	25,577	63.7	10.6	12.5	13.2
1996	25,167	70.5	15.4	10.7	3.5
1997	24,862	74.3	15.7	8.7	1.2
			% of herds in class 1 (0.05≤S/P ratio<0.15)	% of herds in class 2 (0.15≤S/P ratio<0.55)	
1998	24,038	81.3	9.1	9.2	0.4
1999	23,584	85.6	8.8	5.6	< 0.1
2000	21,796	88.3	6.3	5.3	0.1
2001	19,910	91.9	4.7	3.2	0.2
2002	18,771	94.4	3.1	2.2	0.3

Table 2. Herds positive for antibodies against BVDV in pooled milk from primiparous cows during the period 1993-2001 (This test has not been in use after 2001)

Year	No. of herds examined	% antibody positive herds
1993	5,031	70.7
1994	3,228	54.5
1995	3,191	44.3
1996	1,849	44.1
1997 *		
1998	1,415	21.5
1999	924	24.2
2000	100	13.0
2001	53	9.4

* Presentation of results from 1997 is omitted because data disappeared in the process of change of computer system in 1998.

Table 3. Pooled serum samples from young stock positive for antibodies against BVDV during the period 1993-2002

Year	No. of samples examined	% antibody positive samples
1993	5,000	46.5
1994	4,107	38.2
1995	5,347	23.5
1996	3,163	21.9
1997	3,292	16.0
1998	3,407	10.8
1999	3,060	8.6
2000	1,610	8.6
2001	4,198	2.5
2002	2,854	1.8

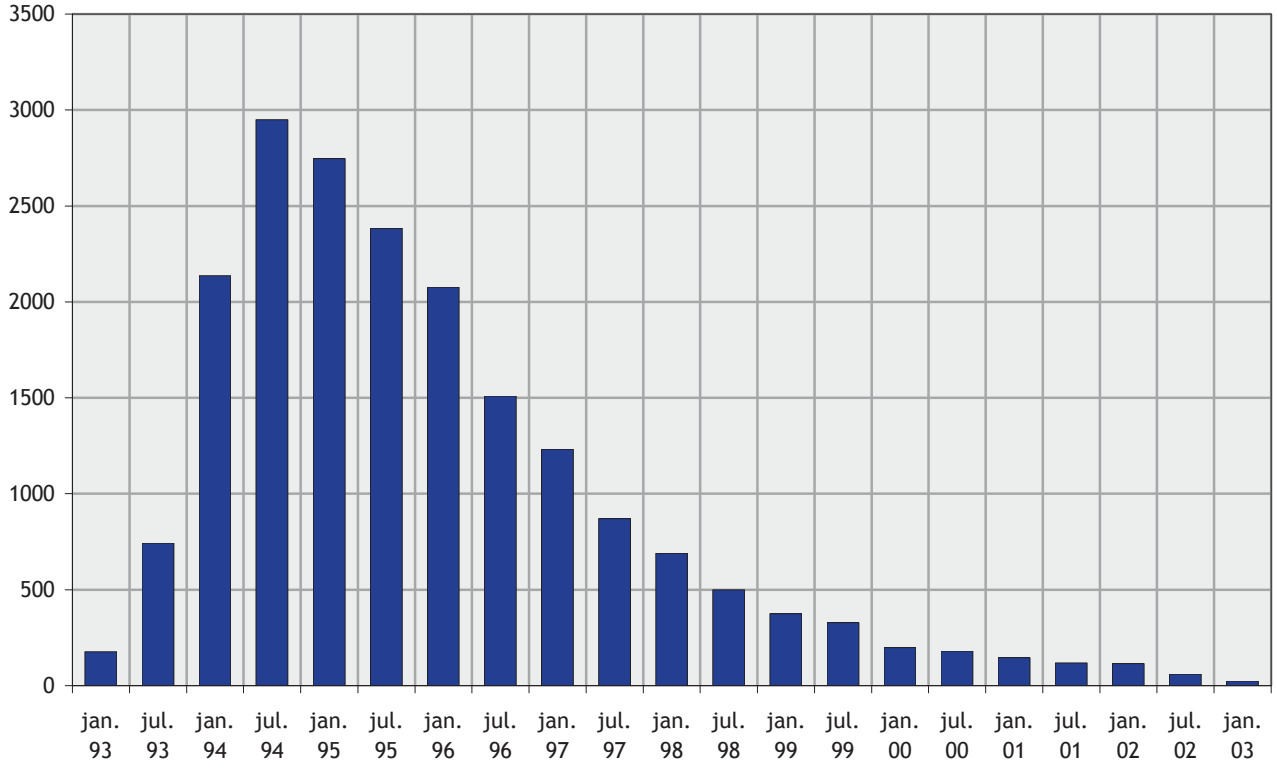


Figure 1. Number of herds with imposed restrictions because of BVDV infection during the period 1993-2003.

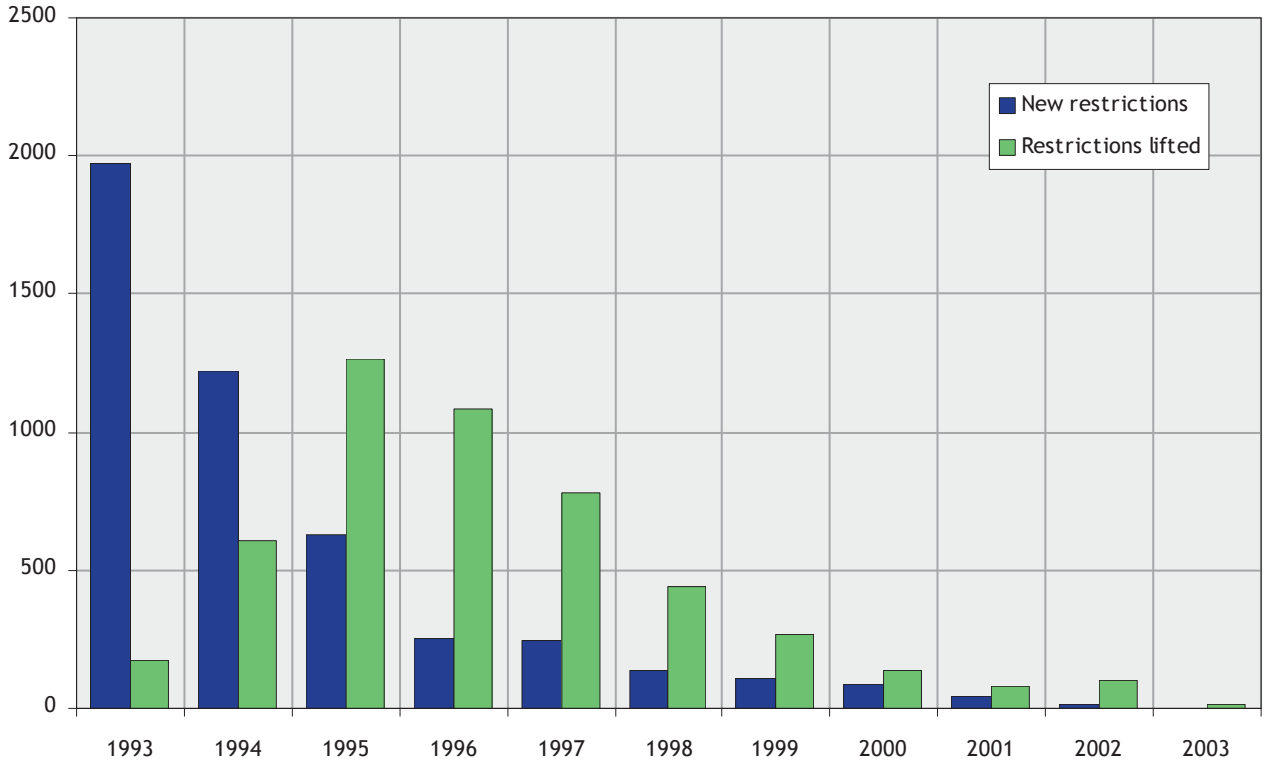


Figure 2. Number of new herds with restrictions imposed/restrictions lifted per year because of BVDV infection during the period 1993-2003.

Aim

The ultimate goal of the programme is to eradicate BVDV from the Norwegian cattle population.

Material and methods

An indirect ELISA test (SVANOVIR®, Svanova Biotech AB, Uppsala, Sweden) is used for measuring antibodies against BVDV in milk and blood (4). An antigen-capture ELISA test (Moredun Animal Health, Edinburgh, Scotland) is used for the detection of BVDV-antigen (5, 6).

Pooled serum samples from 2,100 different dairy and beef cattle herds were examined in 2003 (Table 6). Depending on the level of antibodies in bulk milk, the herds were grouped in one of four classes (Table 4). The results are expressed as S/P-ratio (sample to positive ratio) (7). Pooled milk samples from primiparous cows were not collected in 2003 (Table 2).

Table 4. Classification of bulk milk samples after testing for antibodies against BVDV according to the "sample to positive ratio" of antibodies (AB) in the sample

Class		S/P ratio
0	Not detected AB	< 0.050
1	Detected a small amount of AB	0.050 - 0.149
2	Detected a moderate amount of AB	0.150* - 0.549
3	Detected a great amount of AB	≥ 0.550

* Before 1 January 1998 the cut off value between class 1 and 2 was set at S/P ratio=0.250. The border value was reduced to be able to discover new infected herds at an early stage.

Positive results for antibodies in a pooled serum sample from young animals (eight to twelve months) indicate that BVDV was present in that herd less than one year ago. There is a great risk that one or more animals in such a herd could be persistently infected, therefore, restrictions are imposed on the farm. Identification of such animals must be done by testing blood samples from every individual in the herd for antibodies, and the presence of antigen in antibody negative individuals. In 2003, a total of 1,135 animals from 149 herds were investigated.

In 2001, nearly all beef herds having at least two suckler cows were tested with pooled blood samples from young animals. Very few samples were antibody positive. This indicated a very low prevalence in beef herds and lead to a reduced testing in such herds. In 2002, only 20% of the beef herds were tested in a few counties, which for more than one year had been free of herds with restrictions. The number of counties with this reduced testing scheme was in 2003 increased to 13 of a total of 18 counties.

Results

All dairy herds were tested for antibodies against BVDV in 2003, and nearly 97% of these were negative regarding antibodies against BVDV (Table 5).

Of a total of 2,195 pooled serum samples from 2,100 different dairy and beef cattle herds, 1% was antibody positive (Table 6).

BVDV antigen was found in 1.9% of the individual blood samples tested (Table 7).

Table 5. Norwegian dairy herds classified according to BVDV antibody level in bulk milk in 2003

Year	No. of herds	% of herds in class 0 (S/P ratio<0.05)	% of herds in class 1 (0.05≤S/P ratio<0.15)	% of herds in class 2 (0.15≤S/P ratio<0.55)	% of herds in class 3 (S/P ratio≥0.55)
2003	17,549	96.7	2.1	1.1	0.02

Table 6. Antibodies against BVDV in pooled serum Samples from young stock in 2003

Year	No. of herds examined	% AB positive samples
2003	2,100	1.0

Table 7. Examination of individual blood samples for BVDV antigen during the period 1998-2003

Year	No. of individual samples examined	No. of herds examined	Virus positive samples		Virus positive herds	
			No.	%	No.	%
1998	7,091	780	198	2.8	98	12.6
1999	7,619	648	224	2.9	92	14.2
2000	6,947	423	129	1.9	72	17.0
2001	6,287	386	174	2.8	56	14.5
2002	3,962	284	43	1.1	28	9.9
2003	1,135	149	22	1.9	9	0.8

Discussion

Special zones were established in 2001 in areas with many BVDV infected herds. In these zones specific testing schemes must be followed before animals can be sold or allowed access to common pastures. For two and a half years, from the beginning of 2001, a person was engaged specifically for more intensive follow up of involved veterinarians and farmers when herds were infected. In addition, information to veterinarians, other advisors and farmers about the disease and how to act to avoid reinfection was stepped up (8). Figures 1 and 2 indicate that these new measures are effective in helping to shorten "the tail" of infected herds and thereby achieving the ultimate goal of eradicating BVD.

References

1. Løken, T., Krogsrud, J., Larsen I.L., 1991. Pestivirus infections in Norway. Serological investigations in cattle, sheep and pigs. Acta Vet. Scand. 32, 27-34.

2. Nyberg, O., Lindheim, D., Gudmundsson, S., Eikenæs, O., 2002. The surveillance and control programme for bovine viral diarrhoea (BVD) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 93-101.

3. Nyberg, O., Lindheim, D., 2003. The surveillance and control programme for bovine viral diarrhoea (BVD) in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 81-88.

4. Juntti, N., Larsson, B., Fossum, C., 1987. The use of monoclonal antibodies in enzyme linked immunosorbent assays for detection of antibodies to bovine viral diarrhoea virus. J. Vet. Med. B. 34, 356-363.

5. Fenton, A., Nettleton, P.F., Entrican, G., 1991. Identification of cattle infected with bovine virus diarrhoea virus using a monoclonal antibody capture ELISA. Arch. Virol. (Suppl 3) pp. 169-174.

6. Sandvik, T., Krogsrud, J., 1995. Evaluation of an antigen-capture ELISA for detection of bovine viral diarrhoea virus in cattle blood samples. J. Vet. Diagn. Invest. 7, 65-71.

7. Niskanen, R., 1993. Relationship between the levels of antibodies to bovine virus diarrhoea virus in bulk tank milk and the prevalence of cows exposed to the virus. Vet. Rec. 133, 341-344.

8. Lindheim, D., Nyberg, O., Plym Forshell, K. and Nafstad, O. Completion of the Norwegian bovine virus diarrhoea (BVD) eradication programme – a demanding challenge. In Abstracts from the XXII World Buiatrics Congress, Hannover 2002, p 53.

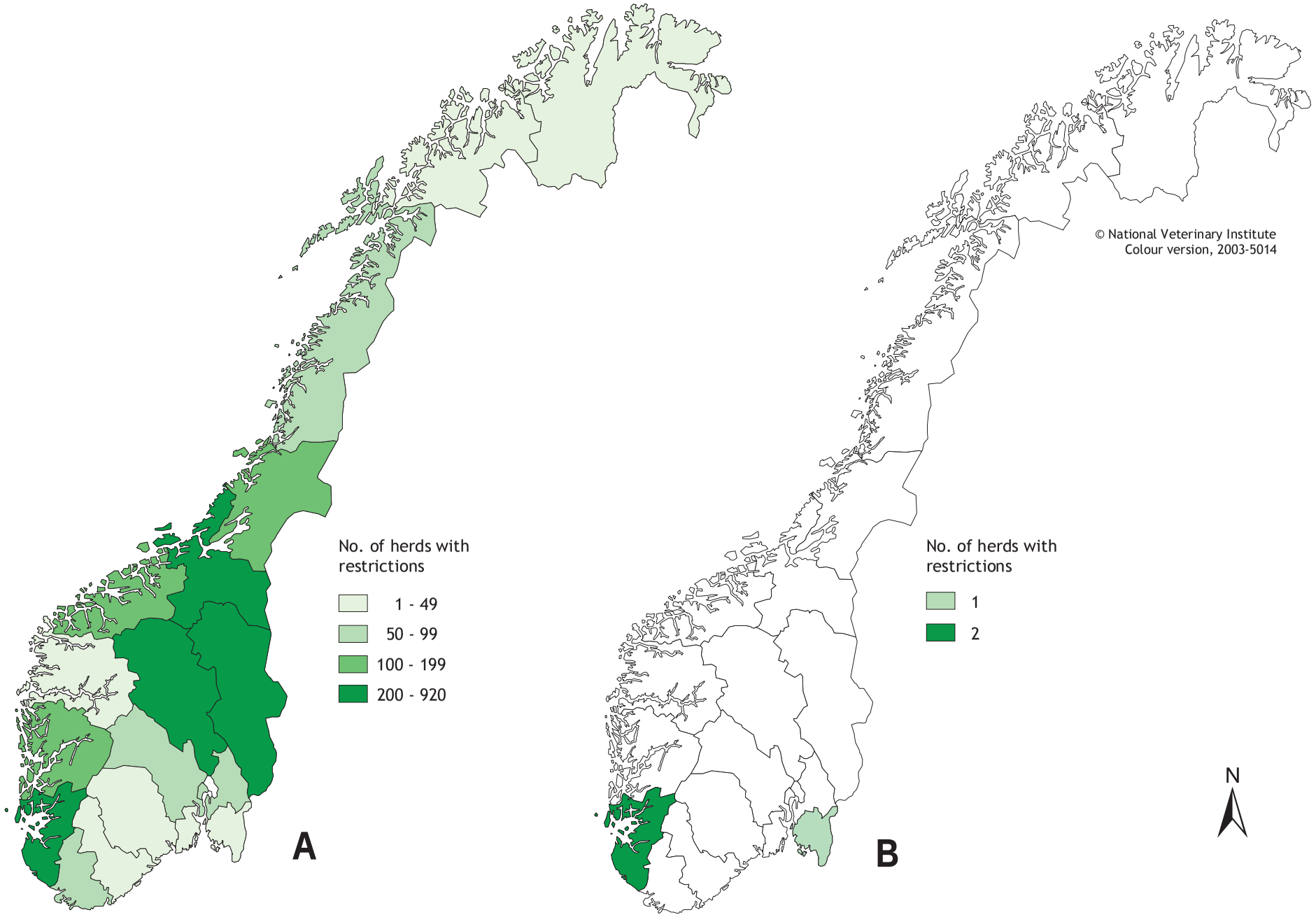


Figure 3. Geographical distribution on county level of herds with restrictions for BVD in 1994 (A) and in 2003 (B).

The surveillance and control programme for bovine tuberculosis in Norway

Annual report 2003

Ola Nyberg

Veterinærinstituttet
National Veterinary Institute

Introduction

Since 1994, the EFTA Surveillance Authority (ESA) has recognised Norway as an "officially bovine tuberculosis free state", as described in ESA Decision 66/94/COL. In 2000, the Animal Health Authority launched a surveillance and control programme for bovine tuberculosis. The programme includes compulsory veterinary inspection of all bovine carcasses at slaughtering, a requirement that has been in force for decades, with submission of suspicious material to the National Veterinary Institute, Oslo.

Aim

The purposes of the programme are to document freedom from bovine tuberculosis, according to the criteria of Directive 64/432/EEC with amendments, and to contribute to the maintenance of this favourable situation.

Material and methods

Criteria for submission of material from slaughterhouses

Submission of lung tissue, lymph nodes and other organs with pathological lesions where bovine tuberculosis can not be excluded, are recommended.

The Food Control Authority collects the samples during routine meat inspection.

Histopathological examination

Tissues are fixed in 10% neutral phosphate buffered formalin for more than 24 hours, processed according to a standard routine protocol, embedded in paraffin and sectioned at 5 µm. All samples are stained with haematoxylin and eosin (HE) and Ziehl Neelsen (ZN) (1).

Bacteriological examination

Samples are examined as described in the OIE manual (1). Samples are homogenised, decontaminated with 5% oxalic acid and centrifuged. The top layer of the sediment is used for culturing and microscopic examination. The sediment is inoculated onto slopes of Petragnani medium, Stonebrink's medium and Middelbrook 7H10 medium. The slopes are incubated aerobically at 37°C for two months and checked every week for growth of acid-fast bacilli, determined by the Ziehl-Neelsen method.

Results and discussion

Table 1 shows the number of samples collected by the Food Control Authority for the monitoring of bovine tuberculosis and the results since the programme started in 2000. In 2003, one sample was examined.

Lack of submitted material from the slaughterhouses indicates a low prevalence of suspicious pathological lesions. With the exception of two single cases in 1984 and 1986, bovine tuberculosis has not been diagnosed in Norway since 1963 (2, 3, 4).

Table 1. Number of samples tested for bovine tuberculosis during the time period 2000-2003

Year	No. of samples	No. of herds	No. of positive	
			Samples	Herds
2000	0	0	0	0
2001	3	3	0	0
2002	0	0	0	0
2003	1	1	0	0

References

1. The OIE manual of standards for diagnostic tests and vaccines 2000.

2. Mørk, T., Bratberg, B., Djønne, B., 2002. The surveillance and control programme for bovine tuberculosis in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 103-107.

3. Nyberg, O., 2003. The surveillance and control programme for bovine tuberculosis in Norway. In: Tafjord Heier, B. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 89-92.

4. Sandvik, O., Næss, B., 1994. Animal Health Standards in Norway. The Royal Ministry of Agriculture, Oslo, Norway. 106 pp.

The surveillance and control programme for shigatoxinproducing strains of *E. coli* (STEC) in Norwegian livestock

Annual report 2003

Torkjel Bruheim
Berit Tafjord Heier

Veterinærinstituttet
National Veterinary Institute

Introduction

Enterohaemorrhagic *Escherichia coli* (EHEC) infection in humans is a serious disease associated with a subset of shigatoxin producing strains (STEC) belonging to different serogroups of *E. coli*. *E. coli* O157/H7 has received most attention, but other serogroups such as *E. coli* O26, O103, O111 and O145 have also been reported as causes of human disease. Three main transmission routes to humans are recognized for *E. coli* O157/H7; food contaminated with faecal material, direct contact with infected animals, and person to person contact. EHEC-infection typically presents with haemorrhagic colitis and may in as much as 10% of the cases cause haemorrhagic uremic syndrome, HUS, or trombotic trombocytopenic purpura. The main reservoir for shigatoxin producing strains of *E. coli* O157/H7 seems to be the intestinal tract in ruminants. Less is known about the epidemiology of other *E. coli* serogroups that may cause disease in humans.

The surveillance programme for STEC in livestock was launched in 1998. During the first three years only investigations for *E. coli* O157 were carried out. Since 2001, *E. coli* O26, O103, O111 and O145 have also been included in the analyses.

Aims

The purpose of the surveillance is to estimate the prevalence of shigatoxin producing strains of *E. coli* O26, O103, O111, O145 and O157 in Norwegian cattle. These bacteria represent a low human health hazard in Norway at present, but experience from other countries indicates that this situation might rapidly change. Frequent monitoring of the status in Norwegian livestock is therefore required.

Materials and methods

During the period from June to October 2003, faecal samples from 137 Norwegian dairy cattle herds were collected. A majority of these herds were organic dairy farms. From each herd nine animals (six heifers/calves and three adult cattle) were sampled. A total of 1,221 samples were collected.

At the laboratory the nine individual samples from each herd were pooled into three samples; two from heifers/calves and one from adult cattle. The pooled samples (total 409) were analysed by methods based on the protocols of Dynal. A sterile swab was put into the faecal material, transmitted to 10 ml room tempered buffered peptone water and incubated for 20 hours at 42°C.

After this non-selective enrichment, the specific O-serogroups of *E. coli* were concentrated by immunomagnetic separation, followed by cultivation on selective agar plates; Chromagar and Sorbitol-McConkeyagar supplemented with Cefexime and Tellurite for *E. coli* O157, and McConkey agar for the other *E. coli*-serogroups.

Presumptive *E. coli* O26, O103, O111, O145 and O157 were tested for agglutination with the respective antisera. Positive isolates were sent to the Norwegian School of Veterinary Science for verification and tested for the presence of shigatoxin (*stx*$_1$, *stx*$_2$) and intimin (*eae*) genes by PCR. Isolates of *E. coli* O157 were also tested for the presence of the *fliC*H7-gene encoding for the flagellar H7-antigen.

Results

E. coli O157/H7 was detected in one of 409 samples (0.2%) representing one herd (herd prevalence 0.7%). The isolate was shigatoxin (*stx2*) and intimin positive, thus representing a potential human pathogen.

E. coli O157/H- was detected in two of 409 samples (0.5%) representing two herds (herd prevalence 1.5%). Genes for shigatoxin or intimin production were not detected in these isolates.

E. coli O26 was detected in 32 of the 409 samples (7.8%) representing 27 herds (herd prevalence 19.7%). None of these isolates presented genes for shigatoxin production, but four had intimin producing genes (representing four herds).

E. coli O145 was detected in 18 of 409 samples (4.4%), representing 15 herds (herd prevalence 10.9%). Genes for shigatoxin or intimin production were not detected in these isolates.

E. coli O103 was detected in 236 of 409 samples (57.7%) representing 124 herds (herd prevalence 90.5%). None of these isolates were detected to have genes for shigatoxin production, but four had intimin producing genes (representing four herds).

E. coli O111 was detected in two of 409 samples (0.5%) representing two herds (herd prevalence 1.5%).Genes for shigatoxin or intimin production were not detected in these isolates.

Discussion

The results of the surveillance in 2003 confirm the conclusions from earlier investigations that shigatoxin producing *E. coli* O157 are still rare in Norwegian cattle (Table 1) (1, 2).

The results also show that although the prevalence for some of the *E. coli* serogroups O26, O103, O111, O145 is high in Norwegian dairy cattle, the bacteria do not represent a significant human health hazard because the presence of the virulence factors shigatoxin and intimin is very low. This agrees well with the results of a similar study performed on samples from Norwegian beef cattle in 2002 (3).

Table 1. Number of herds and cattle tested for *Escherichia coli* O157/H7 during the time period 1998-2003

Year	Population	No. of herds sampled	No. of animals tested	No. of positive herds
1998	Dairy cattle	293	2,617	1
1999	Dairy cattle	281	2,497	0
2000	Beef cattle	165	1,425	0
2003	Dairy cattle	137	1,221	1

Acknowledgment

Thanks to the Norwegian School of Veterinary Science, Department of Food Science for performing the PCR-testing for shigatoxin and intimin.

References

1. Vold, L., Klungseth Johansen, B., Kruse, H., Skjerve, E. and Wasteson, Y. (1998) Occurence of shigatoxinogenic *Escherichia coli* O157 in Norwegian cattle herds. *Epidemiology and Infection* 120, 21-28.

2. Bruheim, T. and Fredriksen B. Overvåkings- og kontrollprogrammet for enterohemoragisk *Escherichia coli* (EHEC) i Norge i 2000. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2000. National Veterinary Institute, Oslo, Norway, pp. 89-92.

3. Opheim, M., Hofshagen, M., Wasteson, Y., Bruheim, T. and Kruse, H. Occurrence of the STEC serogroups 026, O103, O111, O145 and O157 in faecal samples from Norwegian beef cattle. Poster, Biology of VTEC' 03, Edinburgh.

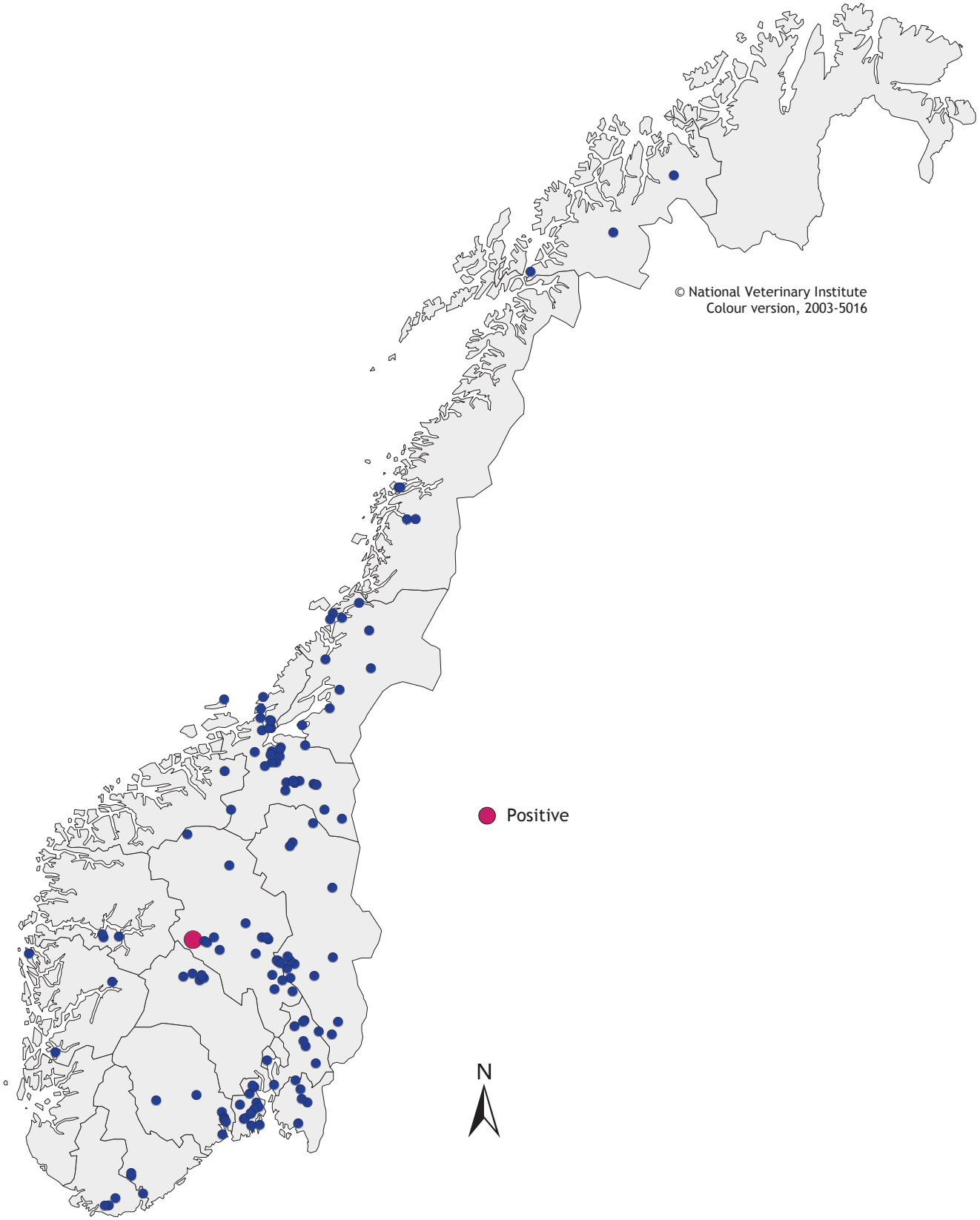


Figure 1. Geographical location of farms tested in the surveillance and control programme for STEC in 2003.

The surveillance and control programme for maedi in Norway

Annual report 2003

Ståle Sviland
Ola Nyberg
Jorun Tharaldsen
Berit Tafjord Heier
Jorunn Mork

Veterinærinstituttet
National Veterinary Institute

Introduction

Maedi is a progressive viral pneumonia in sheep first described in Iceland in 1939 (1). The disease occurs in several European countries as well as in other continents. Visna is caused by the same virus as maedi, but is a neuropathogenic manifestation of the virus. Maedi-visna is classified as a list B disease in the OIE code system as well as in Norway.

In Norway, maedi was officially reported for the first time in 1972 (2). The infection was introduced in the sheep population with imported Texel-sheep in the 1960s. Figure 1 gives an overview of number of new affected flocks registered each year up to 2003. The increased incidence observed in the years from 1972 to 1975 led to a nationwide disease control programme launched by the Norwegian Animal Health Authority in 1975. Movement of all sheep across county borders was forbidden, and governmental restrictions concerning sale and purchase of sheep were imposed on both affected and contact flocks. In these flocks, all sheep more than one and a half years old were tested serologically once annually during a five year period. The flocks were not allowed to share breeding rams with other flocks during the mating season. Inspection of sheep lungs at the slaughterhouse during meat inspection was intensified nationwide. All affected flocks were slaughtered on a voluntary basis.

As no new infected flocks were detected during the early nineties, the restrictions were lifted in all flocks by the end of 1994. But in 1995, maedi was again diagnosed at slaughter in a ram from a flock in the Hordaland county. During the period 1995-97, 29 infected herds were detected in the counties of Rogaland and Hordaland in western Norway. Of these, 24 flocks were detected in 1995, four flocks in 1996, and in one flock in the spring of 1997 (Figure 1).

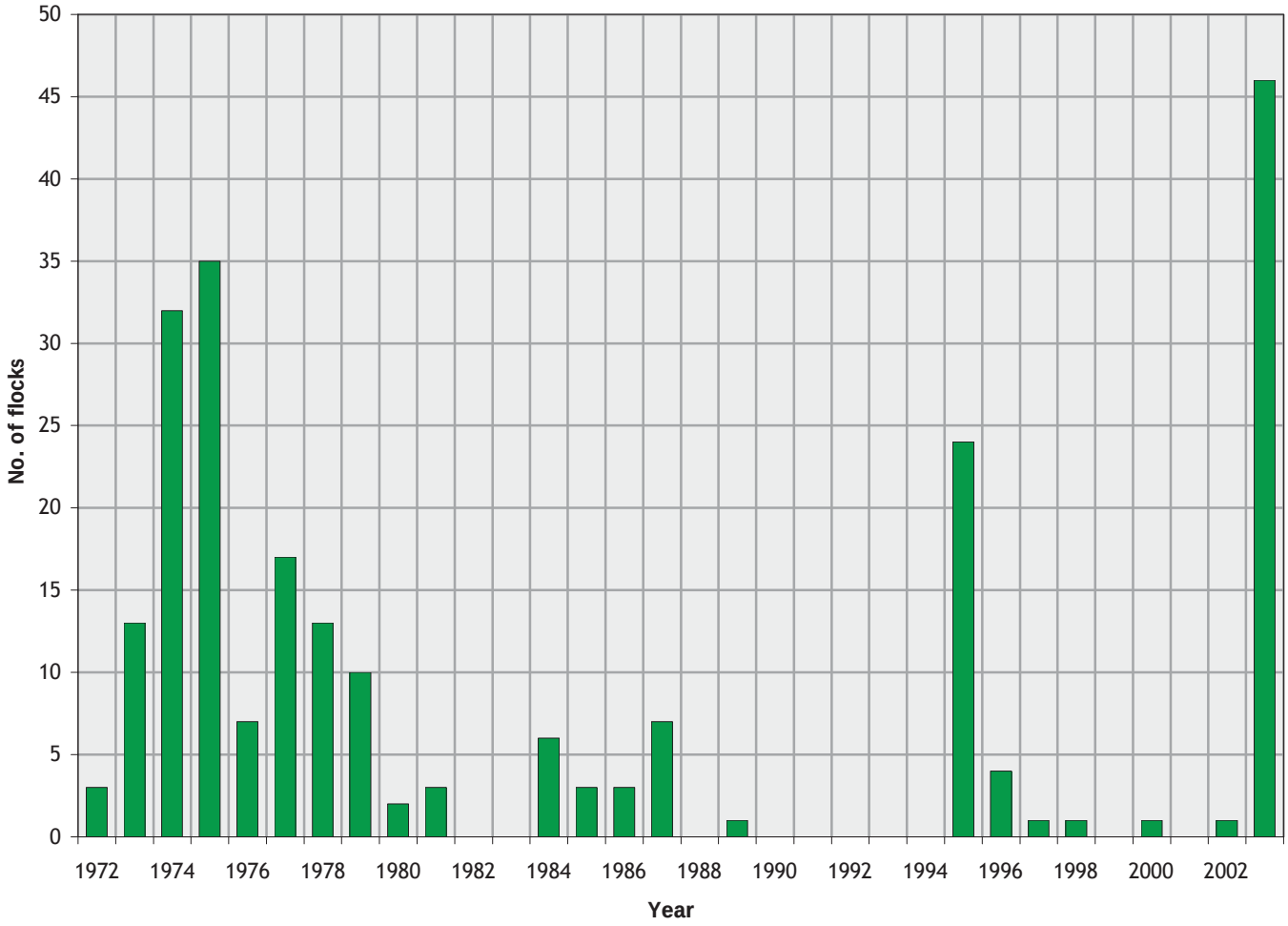


Figure 1. The number of new infected flocks with maedi registered during the period 1972-2003. The bar for 2003 shows sero-positive flocks from the outbreak in Nord-Trøndelag county (45 flocks) and seropositive flocks discovered in the programme.

A control programme for maedi-visna was initiated in July 1997 including serological testing for maedi-visna in all flocks in high-risk regions (Rogaland and Hordaland counties) during a seven years period (3). Table 1 presents the target and study population in the programme. The positive flock in 1997 was diagnosed before the programme started. In the rest of the country the surveillance was limited to inspection at slaughter.

In November 2002, post mortem examinations of lungs from two diseased sheep from different farms in Nord-Trøndelag county showed histopathological changes consistent with maedi. The diagnoses were confirmed by serological tests of blood samples.

The prevalence of positive animals was high in both flocks (55% and 64%). In one flock there had been no contact with other flocks, whereas the other played a major role as supplier of breeding animals to a large ram circle consisting of approximately 130 flocks in 12 different municipalities. Actually, this large ram circle was a close cooperation between several smaller ones. Additionally, sheep from the original flock had been transferred to circa 120 other flocks, including six flocks in the southern part of Norway. During the investigation more than 15,000 sheep in 300 flocks were serologically examined for maedi-visna infection. Two hundred and fifty flocks were put under restrictions, of these 50 flocks were found to be seropositive against the infection.

This outbreak demonstrated that the maedi-visna infection was more widespread in Norway than previously anticipated, and necessitated a new nationwide control programme.

The new surveillance and control programme for maedi-visna

In April 2003, at a request from the Norwegian Animal Health Authority, the National Veterinary Institute was asked to make a draft for a new nationwide surveillance and control programme for maedi. It was a prerequisite that it should be able to detect infected flocks more efficiently than the old programme, the expenses, however, should not exceed the costs of the existing programme to any great extent. These conditions limited the number of flocks and animals to be included in the programme annually. Thus, the flocks participating in ram circles seemed to be a very suitable population for the purpose. The ram circles represent the top of the breeding system and very few rams used for breeding in the Norwegian sheep population are recruited from outside the ram circles. Approximately 2,000 flocks were part of this breeding system in 2003 of a total of more than 18,000 sheep flocks. It was decided to start with the population participating in the ram circles and then gradually include more of the other flocks as the examined flocks were declared free of the maedi-visna infection. The programme was made in collaboration with the Norwegian Animal Health Authority, the Norwegian Association of Sheep and Goat Breeders (NGS) and the Norwegian Sheep Health Service.

The new programme started in November 2003.

Materials and methods

The old programme

The sampling frame for the flock selection was the governmental database for production subsidies. In this register, the data for the sheep flocks are updated once annually on 31 December. The database contains information on the identification of the owner, geographic location of the flock and the number of winter-fed sheep. Only sheep flocks located in the counties of Rogaland and Hordaland were eligible for sampling. Flocks positive for antibodies against maedi-visna virus during the period from 1995 and their contacts were excluded, as were the flocks tested during the previous years in the surveillance and control programme. The flocks to be sampled were selected randomly and stratified on flock size.

The 2003 sampling plan was communicated to the District Veterinary Officer in the Norwegian Animal Health Authority being responsible for blood sampling. The number of samples to be tested in each flock was based on a 95% confidence of detecting a within-flock prevalence of at least 10%, assuming a 100% sensitive test. Animals older than one and a half years were considered high-risk and therefore selected for testing. The estimated number of animals to be sampled per flock varied from all animals older than one and a half years in the smallest flocks to a maximum of 26 animals per flock.
An agar gel immunodiffusion test (AGIDT, Meditect, Veterinary Laboratories Agency, Weybridge, UK) was used to screen sera for antibodies against maedi-visna virus.

The new programme

The NGS's register of ram circles and their member flocks constitutes the basis population in the programme. In addition sheep from 200 randomly selected flocks not belonging to any ram circle will also be included, which means serological testing of approximately 68,000 sheep during a two year period.
To keep the expenses within an acceptable frame, half of the 2,000 flocks will be tested annually. All flocks belonging to the same ram circle are tested at the same time. Flocks belonging to farms with both sheep and goats (approximately 300 farms) will initially not be tested because of the cross reactions in the serological tests between ovine lentivirus infection and caprine arthritis encephalitis virus infection (CAEV) in goats, but

they will be examined by other means later in the programme.

The outbreak in Nord-Trøndelag county showed that many of the positive flocks had only a few seropositive animals (50% of the positive flocks had prevalence less than 10%). The sample size per flock was adjusted so that if none of the tested animals are seropostive, the prevalence of maedi-visna infected animals in a flock is less than 6%, given a confidence level of 95% and with a 100% test sensitivity. I.e. 30 animals per flock will be sampled in flocks with less than 100 sheep, 35 animals are sampled in flocks with 100 to 200 sheep and 40 animals per flock will be tested in flocks with more than 200 animals. All rams and the oldest sheep (among those more than two years old) in the flock should be sampled. The programme is based on serological examination of blood samples from the selected sheep for antibodies against maedi-visna virus with the ELISA from Pourquir (ELISA CAEV/MAEDI-VISNA serum verification kit, Institut Pourquier, Montepellier, France). The ELISA is supposed to be more sensitive than the traditionally used agar gel immunodiffusion test (AGIDT), while the specificity is almost equal for the two tests. Seropositive ELISA-results are verified by another ELISA (ELITEST – MVV # CK104A, Hyphen BioMed, Andrésy, France) and the AGIDT. Experience from this test-regime implemented during the recent outbreak has shown that the proportion of inconclusive/false positive results is less than one percent. By inconclusive results, new blood samples from the animals will be taken one to two months after the first sampling.

The meat inspectors at the abattoirs also play an important role in the programme by monitoring sheep and especially sheep lungs for detection of suspicious cases consistent with maedi-visna infection.

Results

The old programme

Table 1. The number of flocks and sheep tested in the old Norwegian surveillance and control programme for maedi-visna virus during the period 1997-2003

Year	No. of flocks in the population	No. of flocks sampled	No. of animals tested	No. of positive flocks
1997	6,301	469	8,745	0
1998	6,192	1,478	28,207	1
1999	6,161	1,459	27,990	0
2000	6,112	1,301	24,478	1
2001	6,037	642	11,714	0
2002	5,773	737	12,961	0
2003	5,378	386	5,678	0

The geographical distribution of the Norwegian sheep population and the tested flocks at the municipality level is shown in Figure 2.

The new programme

Table 2. The number of flocks and sheep tested in the new Norwegian surveillance and control programme for maedi-visna virus in 2003

Year	No. of flocks included in the programme	No. of flocks sampled	No. of animals tested	No. of positive flocks
2003	2,227	456	13,951	1

The new surveillance programme started at the end of November 2003, which means that the figures in Table 2 represent less than two months of sampling. During this period, 17% of the flocks which all were parts of the ram circles were examined. Four sheep in one flock that comprised 120 sheep in the county of Hordaland became seropositive.

Discussion

The old programme

In the Norwegian surveillance and control programme all the flocks in the counties of Rogaland and Hordaland were tested for the presence of antibodies against maedi-visna virus within a seven years period. In the other parts of the country the sheep population was passively surveyed for maedi by the lung inspection carried out during the meat control and by veterinarians in clinical practice. The two included counties were regarded as high-risk areas and it was considered most cost-efficient to restrict the testing to these counties relative to a nationwide programme.

Maedi is a progressive disease and humoral antibodies may not be detected in infected sheep until several years after infection. Assuming a diagnostic test with a sensitivity of 100%, there is a 95% probability that at least one of the tested animals will be positive if the within-flock prevalence of maedi is 10% or above. It transpired that in some of the contact flocks previously tested only 6% of the animals had been seropositive against maedi-visna virus. Supposing a 95% confidence level the number of animals tested with the current diagnostic test will not be sufficient to detect the infection in flocks with low prevalence. Based on the old surveillance and control programme one could not conclude that a tested flock was not infected, but our investigation indicated that infected animals might occur in a very small number.

The new programme

Besides being nationwide, the aim of the new programme is to increase the sensitivity in discovering maedi-infected flocks compared to the previous programme without increasing the costs per flock to any extent. Two measures are established to achieve this. The number of sampled animals per flock is increased and a more sensitive, but less labour-intensive test is introduced.

The ELISA is also more objective and less dependent of the operator's skill than the AGIDT. The ELISA is claimed to be as specific as the AGIDT, however, to gain experience with the different tests and to ascertain the sensitivity and the specificity for the ELISA from Pourquier, another ELISA and the AGIDT are used when the first test is positive. The disadvantage with this test regime is that in some cases the results are difficult to interpret which leads to more inconclusive results and testing of new blood samples from the flock are then required.

Results from previous control programme for maedi-visna discovered a prevalence of circa 1%, whereas results from the new programme show a preliminary prevalence of 0.2%, however, considering the relatively small proportion of flocks tested, this prevalence is not necessarily accurate and has to be interpreted carefully. Knowledge about the distribution of the disease so far indicates that it is regionally clustered and that a more extensive spread of maedi-visna is probably prevented by the restriction against transfer of sheep across county borders.

References

1. Martin, W.B., Aitken, I.D., 1991. Diseases of Sheep, 2nd ed, Blackwell Scientific Publications, Great Britain.

2. Krogsrud, J., Larsen, H.J.S., Rimstad, E., 1996. Mædi og lungeadenomatose. (Maedi and lung adenomatosis). Nor. Vet. Tidsskr. 108, 729-736.

3. Mork, J., Jarp, J., 2002. The surveillance and control programme for maedi in Norway. In: Fredriksen, B., Mørk, T. (Eds). Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 109-115.

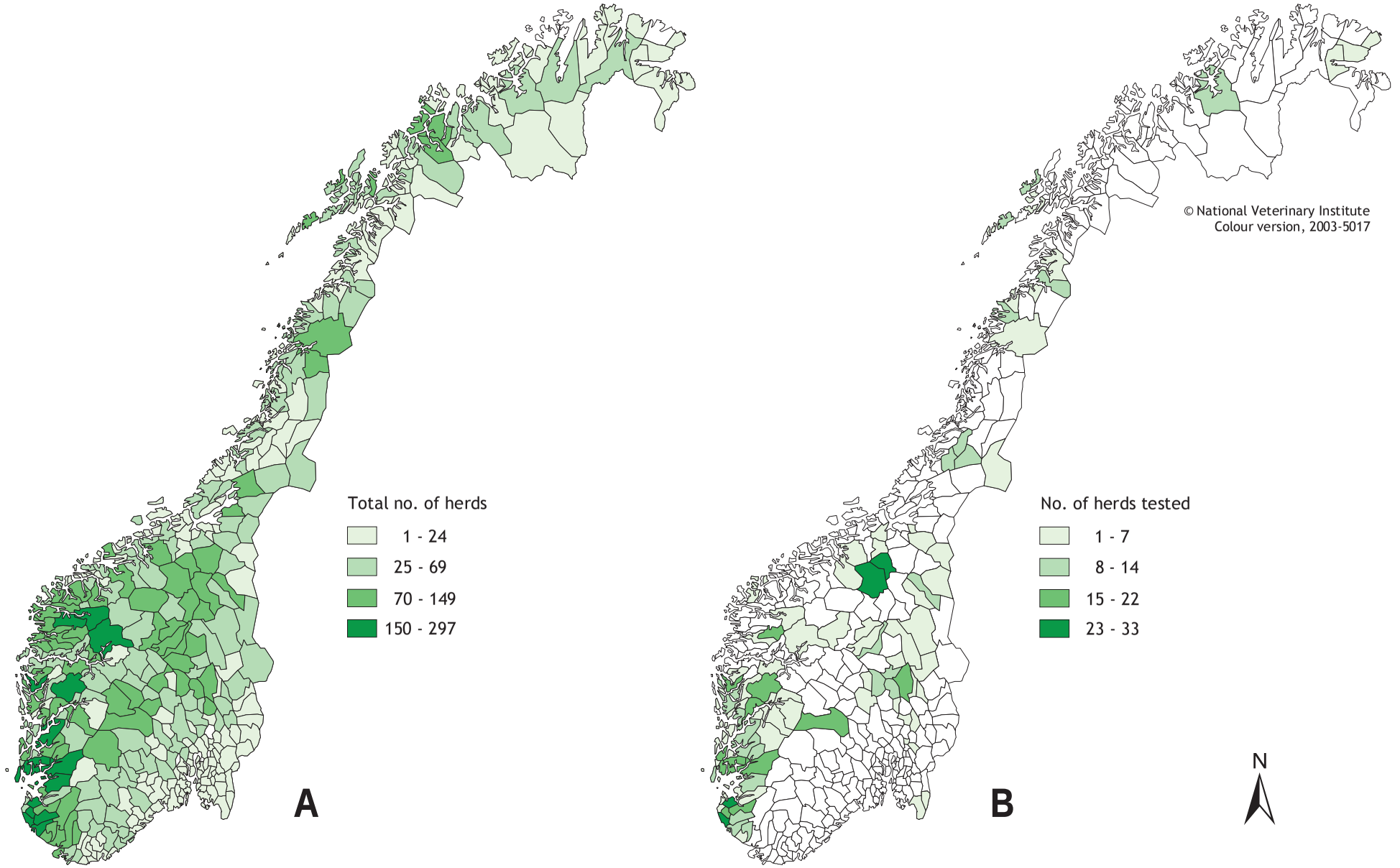


Figure 2. Geographical distribution on municipality level of the sheep herd population (A), and of the sheep herds tested in the surveillance and control programme for maedi (B) in 2003.

The surveillance and control programme for scrapie in Norway

Annual report 2003

Mette Valheim
Sylvie L. Benestad
Bjørn Bratberg
Olav Eikenæs
Petter Hopp
Torfinn Moldal
Jorunn Mork

Veterinærinstituttet
National Veterinary Institute

Introduction

Scrapie was first diagnosed in indigenous Norwegian sheep in 1981. Increasing numbers of scrapie-infected flocks were identified in the 1990s, culminating with 31 detected flocks in 1996 (Figure 1). By the end of 2002, scrapie had been diagnosed in a total of 75 sheep flocks. Scrapie has never been diagnosed in goats in Norway (1). Scrapie has been a notifiable disease in Norway since 1965, and control measures have involved destruction of all sheep in the affected flocks and in close contact flocks. A national scrapie surveillance and control programme was launched by the National Animal Health Authority in 1997 (2).

In 1998 a new type of scrapie, scrapie Nor98, was detected in Norway. The diagnosis scrapie Nor 98 is verified by Western blot. Scrapie Nor98 differs from classical scrapie in several aspects, including the Western blot profile, the distribution of protease resistant prion protein (PrP^{Sc}) in the brain, and absence of detectable PrP^{Sc} in lymphoid tissue (3).

In 2003, the surveillance programme was adjusted according to the European Union Regulations No. 999/2001 and 1494/2001 and included examination of the following categories of small ruminants:

- all small ruminants with clinical signs consistent with scrapie, irrespective of age
- 6,000 small ruminants older than 18 months, which had died or been killed on the farm, but not slaughtered for human consumption (fallen stock)
- 42,500 randomly sampled healthy sheep and goats older than 18 months slaughtered for human consumption

The sheep and goat farmers were responsible for reporting to the District Veterinary Officers (DVOs), Norwegian Animal Health Authority, all sheep and goats with clinical signs consistent with scrapie, and animals older than 18 months that died or were killed on the farm due to disease. The DVOs evaluated the reported cases and if indicated, either a post mortem examination at a laboratory, or a collection of a brain sample at the farm for laboratory examination were performed. The DVOs also carry out inspection of all goat and sheep flocks every second or third year. The Municipal Food Control Authority sampled slaughtered sheep and goats at the abattoirs, while the National Veterinary Institute was responsible for the laboratory examinations and the reporting of the results.

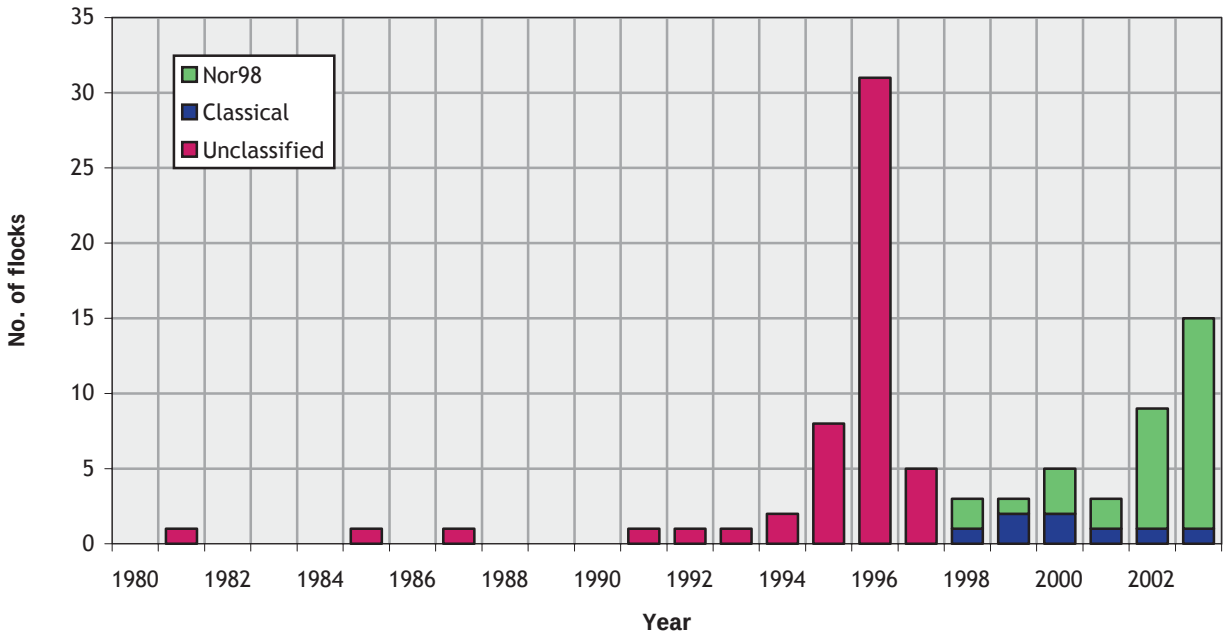


Figure 1. Annual number of sheep flocks diagnosed with classical scrapie and scrapie Nor98 during the time period 1980-2003. Before 1998 the cases were not classified according to type of scrapie, but the majority of the scrapie cases are supposed to be the classical type.

Aims

The aims of the surveillance and control programme are to identify scrapie infected sheep and goat flocks to support disease control, and to estimate the prevalence of scrapie in sheep and goats in the fallen stock and the population slaughtered for human consumption.

Materials and methods

Animals with clinical signs consistent with scrapie

A total of 15 sheep with clinical signs consistent with scrapie were subject to clinical evaluation. The animals were either subject to post mortem examination at a laboratory, or formalin-fixed and unfixed brain halves and medial retropharyngeal lymph nodes were submitted for laboratory examination. All the animals were examined at the National Veterinary Institute.

Surveillance of fallen stock

Samples from approximately 3,460 sheep and 225 goats found dead, or which were killed, and which had shown clinical signs where scrapie could not be excluded, were submitted for examination. The majority of the samples consisted of unfixed *medulla oblongata* obtained through the *foramen magnum* using a specially designed metal spoon, and retropharyngeal lymph nodes. Alternatively the samples consisted of formalin-fixed and unfixed brain halves and unfixed retropharyngeal lymph nodes. The samples were examined at the National Veterinary Institute Oslo.

Abattoir surveillance

Approximately 33,500 randomly collected brain samples from apparently healthy sheep and 1,615 randomly collected brain samples from apparently healthy goats older than 18 months were collected at 26 abattoirs, which in total process more than 95% of the slaughtered sheep in Norway.

The samples were obtained throughout the year, with approximately 70% of the samples collected in August, September and October, which is the main slaughtering season for sheep in Norway. To ensure a proper distribution of the samples, the Veterinary Officers at The Municipal Food Control Authority were responsible for the sampling. According to Regulation (EC) No 1494/2002 the sampling is to be representative for each region and season, and the sample selection should be designed with the view to avoid over-representation of any group as regards the origin, species, age, breed, production type or any other characteristic.

The brain samples consisted of *medulla oblongata*, and often also a small part of the *cerebellum* and midbrain, obtained through the *foramen magnum* using a specially designed metal spoon. The samples were examined at the National Veterinary Institute, Sandnes, Trondheim and Harstad.

Laboratory examination procedures

Clinically suspect animals were subject to histopathological examination of brain tissue and immunohistochemical examination of brain and lymphoid tissue for PrP^{Sc}. In addition, for comparative reasons, a rapid test (Platelia ® BSE ELISA, from June 2nd TeSeE, Bio-Rad*)* was performed on brain and lymphoid tissues. From the fallen stock a pooled brain tissue sample (*obex,* midbrain, cerebral cortex, and *cerebellum*) was initially examined by the rapid test. The abattoir samples (*obex*) were also initially examined by the rapid test. The Platelia ® BSE ELISA / TeSeE Bio-Rad tests were performed according to the protocol given by the manufacturer. Immunohistochemistry and Western blot were used as confirmative tests on the samples from the fallen stock and the abattoirs. Immunohistochemistry was performed using a monoclonal anti-PrP-antibody (F89/160.1.5) (4). A commercially available kit (EnvisionTM, Dako, K4005, CA, USA) was used to enhance the sensitivity of the method. The confirmative tests, immunohistochemistry and Western blot analyses for PrP^{Sc} (WB Sheep & Goat, Bio-Rad), were carried out at the National Veterinary Institute, Oslo, which is the national scrapie reference laboratory.

PrP genotyping

Genotyping of scrapie positive sheep was performed on blood or unfixed brain samples at the Norwegian School of Veterinary Science, Department of Production Animal Clinical Sciences. Genomic DNA was isolated using the 'DNA Isolation kit for Mammalian Blood' (Roche Diagnostics) or DNeasy Tissue kit (QIAGEN). Polymorphisms in the PrP gene were detected through automated sequencing of a PCR-generated product covering codons 99 to 209 of the PrP open reading frame (forward primer 5' AGGCTGGGGTCAAGGTGGTAGC; reverse primer 5' TGGTACTGGGTGATGCACATTTGC).

Prevalence

The scrapie Nor98 prevalence in the fallen stock and abattoir populations was estimated assuming a beta-distribution when using an uninformed prior.

Results

Scrapie was diagnosed in 15 sheep, each case originating in a different flock (Figure 1). One case was reported because the sheep had shown clinical signs consistent with scrapie on the farm. Eight scrapie cases were identified in the fallen stock, and five cases were apparently healthy animals slaughtered for human consumption. The last case was detected in a contact flock under scrapie eradication (Table 1). Scrapie was not diagnosed in goats (Table 1).

Table 1. Brain samples from sheep and goats submitted for examination for scrapie in 2003

Reason for submission to the laboratory	No. of samples	No. of rejected samples	Negative	Positive
Sheep				
Animals with clinical signs consistent with scrapie	15	0	14	1
Fallen stock	3,463	100	3,355	8
Healthy slaughtered animals	33,536 *	13	33,518 *	5
Animals killed under scrapie eradication	1,072	0	1,071	1
Goats				
Animals with clinical signs consistent with scrapie	2	0	2	0
Fallen stock	225	4	221	0
Healthy slaughtered animals	1,615	5	1,610	0
Animals killed under scrapie eradication	0	0	0	0
Total	**39,928**	**122**	**39,791**	**15**

* 160 samples from unspecified small ruminants tested negative. These samples are included in the figures given for sheep.

Table 2. Month and year of birth, reason for submission to laboratory examination, breed and protein genotype of scrapie cases detected in 2003

Case nr	Month and year of birth	Reason for submission to laboratory examination [1)]	Breed [2)]	Prion Protein Genotype	Scrapie type
1	05.1995	healthy slaughtered animals	Spæl Sheep	AA HR QQ	Nor98
2	05.2001	scrapie eradication	Steigar Sheep	VV RR QQ	Classical
3	04.1996	fallen stock	Norwegian Pelt Sheep	AA RR QQ	Nor98
4	04.2000	fallen stock	mixed breed	AA HH QQ	Nor98
5	05.1996	fallen stock	mixed breed	AA RR QQ	Nor98
6	04.1996	fallen stock	mixed breed	AA RR QQ	Nor98
7	04.1997	suspect	Spæl Sheep	AA HR QR	Nor98
8	04.1998	fallen stock	Norwegian White Sheep	AA RR QQ	Nor98
9	1997	healthy slaughtered animals	mixed breed	AA HR QQ	Nor98
10	04.1994	healthy slaughtered animals	Dala Sheep	AA RR QQ	Nor98
11	1997	healthy slaughtered animals	Dala Sheep	AA RR QR	Nor98
12	1997	healthy slaughtered animals	Dala Sheep	AA RR QR	Nor98
13	1997	fallen stock	Norwegian White Sheep	AA RR QR	Nor98
14	1996	fallen stock	Norwegian White Sheep	AA HR QQ	Nor98
15	05.1999	fallen stock	Dala Sheep	AA HH QQ	Nor98

[1)] clinical signs consistent with scrapie/monitoring of fallen stock/monitoring of emergency slaughtered animals and animals showing clinical signs at ante-mortem/monitoring of healthy slaughtered animals/ monitoring of animals killed under scrapie eradication measures.
[2)] crossbred long-tailed breeds: Rygja Sheep, Steigar Sheep, Dala Sheep, Norwegian White Sheep; indigenous short-tailed breed: Spæl Sheep.

Fourteen of the 15 scrapie cases were diagnosed as scrapie type Nor98, based on the unique Western blot profile (Table 2). The prion protein genotype was examined for all the 15 scrapie cases, from which data on individual age and breed were collected (Table 2).

The identity of the flock was reported for 35,635 (93.6%) of the total of 38,086 samples from sheep. In the event of a positive sample, the flock identity of the remaining samples could be traced via the carcass-number. The 35,635 samples were collected from 9,685 different sheep flocks. The mean number of animals tested per flock was 3.6 (range 1-49, flocks eradicated due to

scrapie are excluded). From 4,488 flocks more than two samples were tested.
The identity of the herd was reported for 1,732 (94.0%) of the total of 1,842 samples from goats. In the event of a positive sample, the herd identity of the remaining samples could be traced via the carcass number. The 1,732 samples were collected from 477 different goat herds. The mean number of animals tested per herd was 4.5 (range 1-27).
The geographical distribution on a municipality level of the sheep and goat populations is shown in Figures 2A and 2B. The origin of the sheep and goat samples and the origin of the scrapie cases are shown in Figures 3A and 3B.
The prevalence of scrapie in the fallen stock of sheep was estimated to 0.28% (0.14-0.43%), (95% confidence interval [CI]), and the prevalence of scrapie in sheep slaughtered for human consumption was estimated to 0.02% (0.008-0.031%), (95% CI).

Discussion

Scrapie Nor98 was diagnosed in 14 sheep and classical scrapie in one sheep in 2003, each case originating in different flocks.
The 14 scrapie Nor98 cases were verified by Western blot analysis (3). The ages and genotypes of these sheep, and the results of the immunohistochemical examinations, were in accordance with the previous experience of scrapie Nor98 (5, 6).
All the animals in these 14 scrapie Nor98 flocks were killed and animals older than 12 months were examined for PrP^{Sc}, but no additional animals with scrapie Nor98 were detected in these flocks. This result as well as similar findings in preceding years suggests that scrapie Nor98 is, if contagious at all, less contagious than classical scrapie.

Nine out of 14 cases carried prionprotein genotypes rarely associated with classical scrapie, while the remaining cases carried susceptible genotypes (Table 2). Only one (case nr 7) of the 14 animals with a scrapie Nor98 diagnosis was reported to show clinical signs consistent with scrapie on the farm, while eight scrapie Nor98 cases were detected through the surveillance of fallen stock, and five cases were identified through the surveillance of apparently healthy slaughtered sheep. This indicates that sheep with scrapie Nor98 rarely show clinical signs that are associated with scrapie. The main clinical sign previously observed in scrapie Nor98 cases has been ataxia.

Scrapie Nor98 was diagnosed in several different breeds, and the sheep were between three and nine years old, the mean age was six years (Table 2). In contrast, the mean age of cases with classical scrapie has been 3.5 years.
Scrapie Nor98 has now been diagnosed in most parts of Norway with cases detected in 14 of the 19 counties. The classical form of scrapie has been detected only in the western part of Norway (3 counties) and in Nordland County.

One scrapie case (case nr. 2) carried the susceptible prionprotein genotype VRQ/VRQ, and the Western blot profile was consistent with the classical form of scrapie. The animal originated in a contact flock to a flock with one case of classical scrapie in 2002. The sheep was only two years old and without clinical signs, but was detected when the flock was killed under scrapie eradication.

The prevalence of scrapie Nor98 in the fallen stock was estimated to 0.28% (0.14-0.43%), (95% CI), which was not significantly different from the estimated prevalence in 2002 (0.20% [0.06-0.48%], [95% CI]). The prevalence of scrapie Nor98 in sheep slaughtered for human consumption was estimated to 0.02% (0.008-0.031%), (95% CI), which was lower, but not significantly different from the estimated prevalence for 2002 (0.03% [0.008-0.065%], [95% CI]), but significantly different from the estimated prevalence for 2001 (0.13% [0.03-0.32%], [95% CI]) (5, 6). The results may indicate a steady prevalence of the disease.
The scrapie Nor98 prevalence in the fallen stock was calculated to be about 16 times higher than in the abattoir population. This result indicates that scrapie Nor98 is associated with increased mortality, even if distinct clinical signs are not observed. However, some of the animals in the fallen stock population had an additional diagnosis that could explain why the animal was killed or died. The higher prevalence in the fallen stock population clearly shows that surveillance of fallen stock is far more efficient than surveillance of healthy slaughtered animals.

The difference between the number of examined sheep from fallen stock (3,363) and the calculated number according to EU regulation 1494/2001 (6,000) may partly be due the fact that about 60% of the fallen stock population die while on remote mountain and forest pastures where predatory animals are commonly found. An additional explanation may be a lack of information to the sheep and goat farmers concerning their duty to report to the District Veterinary Officer all small ruminants that die, or are killed due to disease, on their farms. The difference between the number of samples from the slaughtered population (33,518) and the calculated number according to EU regulation 1494/2001 (42,500) is mainly due to a 25% reduction of slaughtered animals older than 18 months compared to the prognosis for 2003.
However, the number of animals examined in both populations is sufficient to estimate the prevalence of scrapie Nor98. The classical form of scrapie was not detected in the active surveillance despite examination of about 38,000 animals, a result that indicates a very low prevalence of this type. Furthermore, the control component of the programme is also ensured due to the surveillance of animals with clinical signs, and the examination of 3,300 animals from the fallen stock in a sheep population consisting of merely 825,000 sheep older than 18 months.

Acknowledgment

The authors thank the Norwegian School of Veterinary Science, Department of Production Animal Clinical Sciences for the PrP-genotyping and all who have contributed to sampling, preparation and examination of the samples.

References

1. Hopp, P., Bratberg, B., Ulvund, M.J., 2000. Skrapesjuke hos sau i Norge (Scrapie in sheep in Norway), Nor. Vet. Tidsskr. 112, 368-375.

2. Thorud, K., Hagen, G., 2001. Die Scrapiebekämpfung auf nationaler Ebene (National eradication of scrapie). In: Prionen und Prionkrankheiten/hrsg., Hörnlimann, Beat von (Ed), Walter de Gruyter, Berlin, pp. 506-509.

3. Benestad, S.L., Sarradin, P., Thu, B., Schönheit, J., Tranulis, M.A., Bratberg, B., 2003. Cases of scrapie with unusual features in Norway. Vet. Rec. Cases of scrapie with unusual features in Norway and designation of a new type, Nor98. Vet. Rec. 2003 Aug 16; 153 (7): 202-208.

4. O'Rourke, K.I., Baszler, T.V., Miller, J.M., Spraker, T.R., Sadler-Riggleman, I., Knowles, D.P., 1998. Monoclonal antibody F89/160.1.5 defines a conserved epitope on the ruminant prion protein. J. Clin. Microbiol. 36, 1750-1755.

5. Valheim, M., Benestad, S.L., Hopp, P., Bratberg, B., 2002. The surveillance and control programme for scrapie in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 117-125.

6. Valheim, M., Benestad, S.L., Hopp, P., Bratberg, B., 2003. The surveillance and control programme for scrapie in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 99-107.

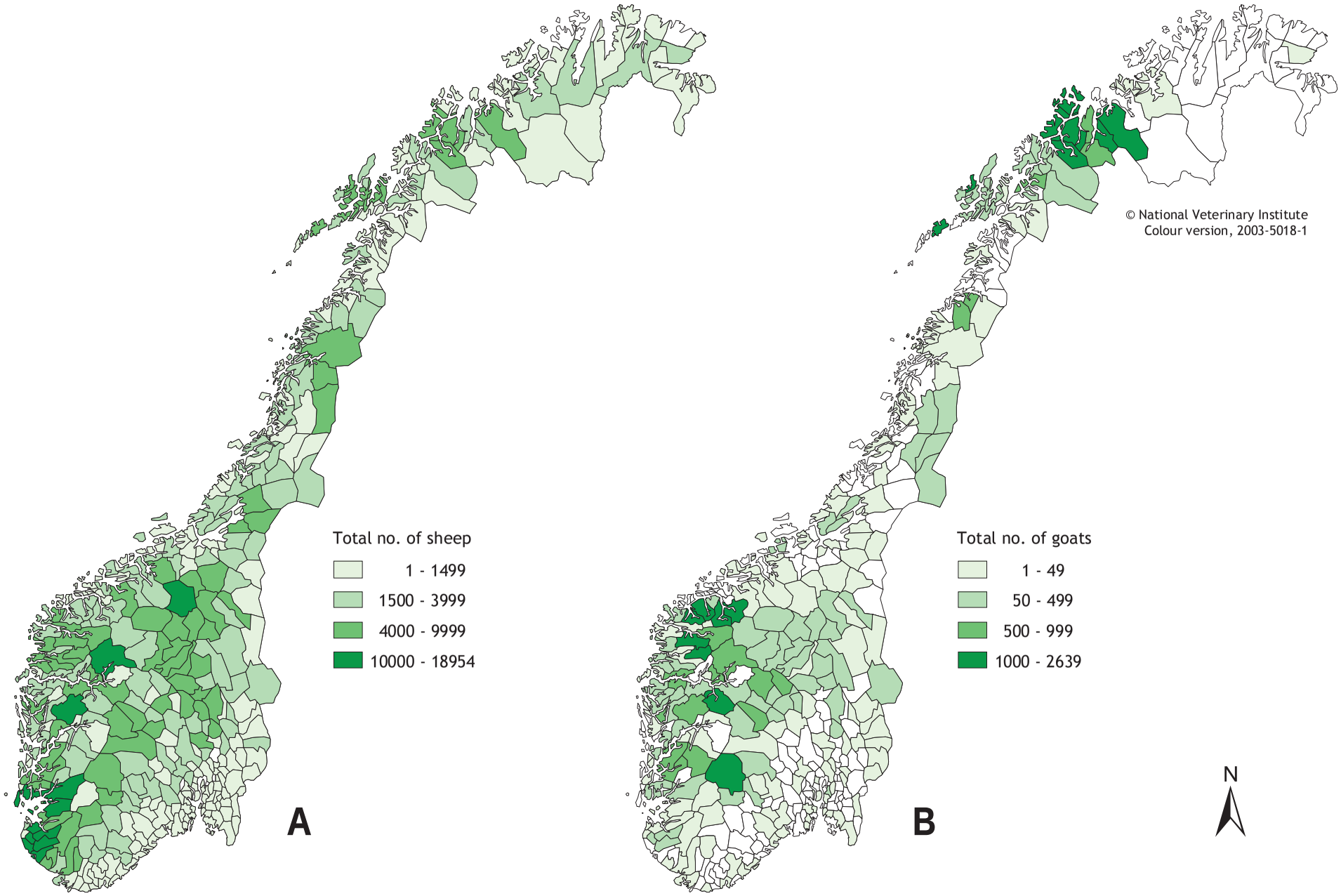


Figure 1. Geographical distribution on municipality level of the sheep population (A) and the goat population (B) in 2003.

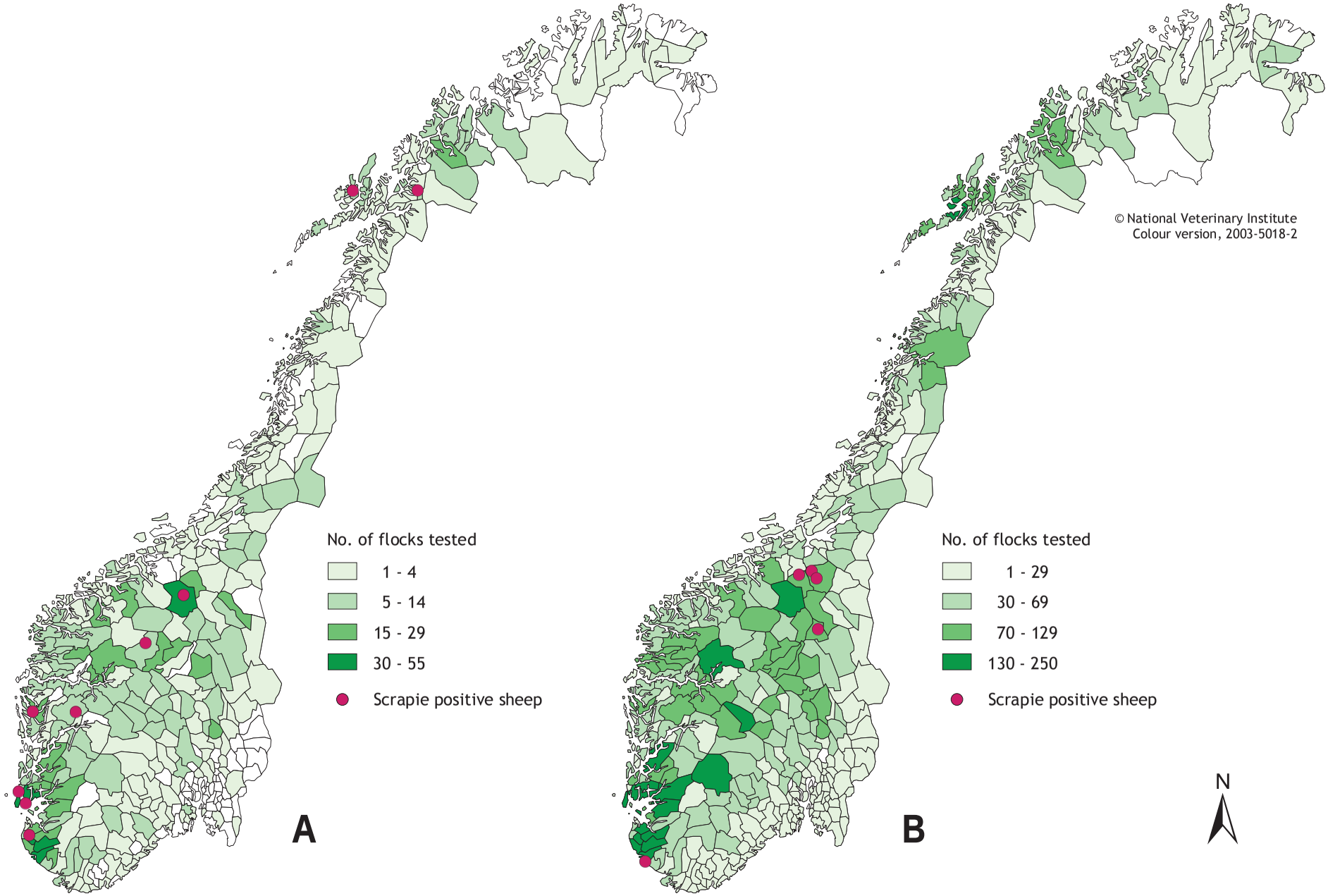


Figure 2. Geographical distribution of sheep and goat flocks in which clinical suspects and fallen stock were tested for scrapie (A), and of the sheep and goat flocks tested in the abattoir surveillance (B) in 2003.

The surveillance and control programme for specific virus infections in swine herds in Norway

Annual report 2003

Petter Hopp
Jorun Tharaldsen

Veterinærinstituttet
National Veterinary Institute

Introduction

The EFTA Surveillance Authority (ESA) has recognised the swine population in Norway as free from Aujeszky's disease (AD) since 1 July 1994, and defined certain additional guarantees to protect the swine health status in Norway. Decisions concerning the additional guarantees relating to AD for pigs destined for Norway are described in ESA Decision 75/94/COL, amending ESA Decision 31/94/COL, later replaced by ESA Decision 226/96/COL.

The national surveillance and control programme for specific virus infections in swine was launched in 1994 in order to document the status of AD, transmissible gastroenteritis (TGE), and porcine respiratory corona virus (PRCV) in the Norwegian swine population. Porcine respiratory and reproductive syndrome (PRRS) and swine influenza (SI) were included in the programme in 1995 and 1997, respectively.

The results from previous years are presented in Figure 1. The Norwegian Animal Health Authority was responsible for the implementation of the programme, while the National Veterinary Institute was responsible for planning, laboratory analyses and reporting.

AD, PRRS, TGE and PRCV have never been detected in Norwegian pigs. Antibodies against SI (H_3N_2) were detected once in 1998 in pigs in a multiplier herd tested in the National surveillance programme. No clinical signs of the disease were observed.

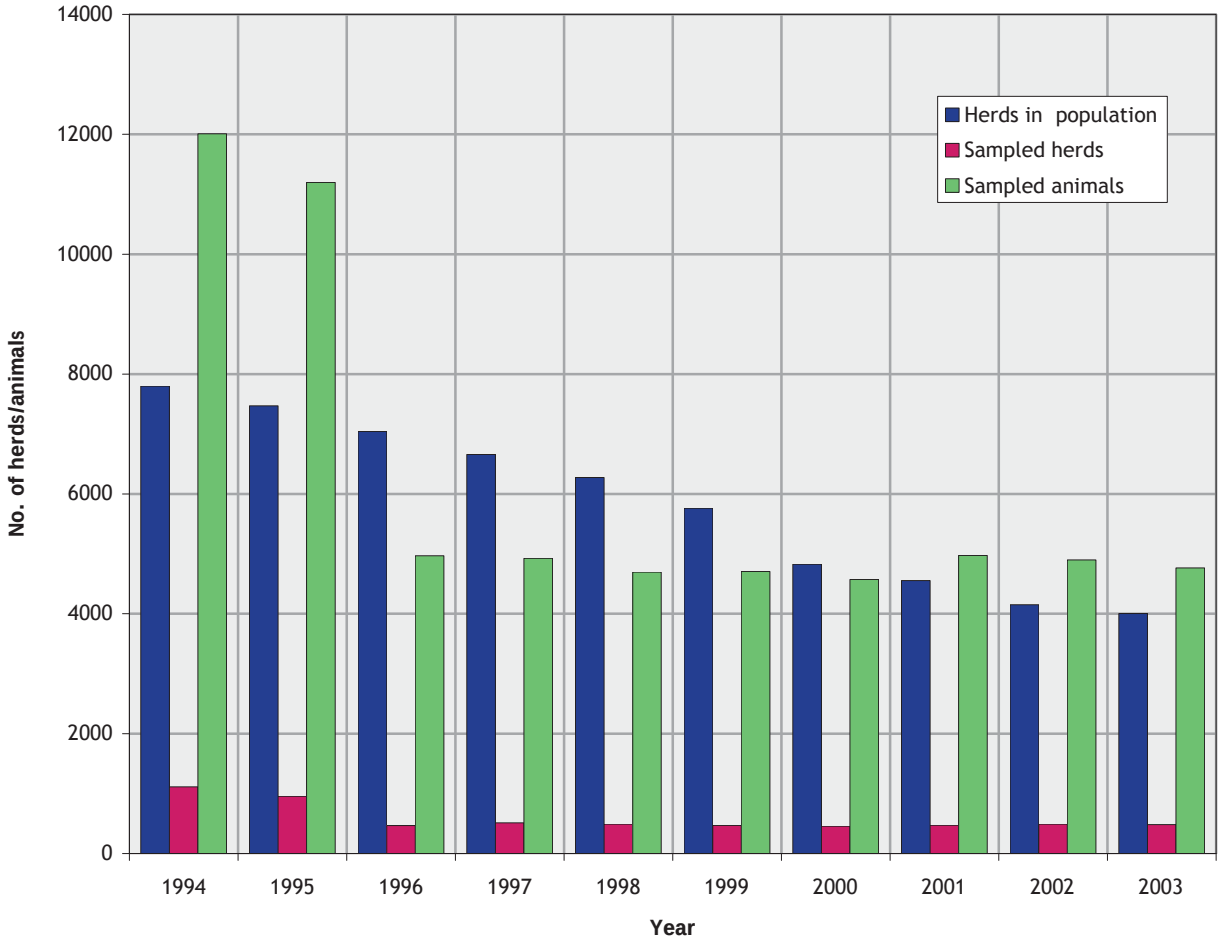


Figure 1. The Norwegian surveillance programme for specific virus infections during the time period 1994-2003.

Aims

The aims of the programme are, through serological surveillance, to document freedom from specific infectious diseases in the Norwegian swine population and to contribute to the maintenance of this favourable situation.

Material

The surveillance of swine herds is focused on the breeding population of conventional swine. All elite breeding and multiplying herds were tested, and in addition, a random selection of the remaining breeding population and production animals was included in the programme. Because the counties Østfold, Akershus, Vestfold and Rogaland were considered to be "high risk areas", a relatively larger proportion of farms from these counties was tested.

The random selection was conducted from the group of all pig herds receiving governmental production subsidies according to records of 31 July 2002. The register included a total of 4,554 commercial swine herds. Based on this, the sampling plan specified 300 combined herds, 179 elite breeding and multiplying herds and 60 fattening herds. Samples from selected fattening herds were collected at five different abattoirs. Samples from 10 pigs were to be collected from all the selected farms.

Methods

All the serological analyses were performed at the National Veterinary Institute in Oslo except from the PRRS-analyses, which were run at the Danish Veterinary Institute, Department of Virology, Lindholm, Denmark.

AD

All serum samples were tested for antibodies against AD virus in a commercial blocking ELISA (SVANOVIR™). The test detects antibodies against glycoprotein I on the surface of the virus. This antigen is not present in most vaccines, and consequently, the test discriminates between infected and vaccinated animals.

TGEV/PRCV

A combined blocking ELISA (SVANOVIR™) was used for detection of antibodies against TGEV/PRCV. Depending on the reaction pattern of two different monoclonal antibodies against TGEV/PRCV and TGEV respectively, the test is able to distinguish between antibodies against TGEV and PRCV.

PRRS

All serum samples were tested for antibodies against PRRS virus using a blocking ELISA developed at the Danish Veterinary Institute for Virus Research (method no. 06.0058). This test detects both the European and the American strain (the strain used in vaccines, which also circulates among Danish pigs).

Swine influenza

To test for swine influenza, the samples were analysed for antibodies against the serotypes H_1N_1 and H_3N_2 in the hemagglutination inhibition test (HI). The reagents were produced at the National Veterinary Institute in Oslo.
All individual samples that give an inconclusive or positive result in any of the ordinary routine testings, are followed up by specified reference tests.

Results

All serum samples were negative in all analyses.

The National Veterinary Institute received 4,764 individual blood samples suitable for testing. All samples were tested for AD, SI, and PRRS, PRCV and TGE. The distribution of tested herds in relation to type of production is given in Table 1. The mean number of animals tested per farm was 9.9 (range 3-20).

The geographical distribution of sampled herds relative to the geospatial distribution of the swine population is presented in Figure 2.

Table 1. Distribution of swine herds in the surveillance and control programme related to the type of production in 2003

Category	No. of herds tested	% of herds tested	Total no. of animals tested	% of animals tested
Breeding herds	162	33.6	1,619	34.0
Integrated and piglet producing herds	269	55.8	2,646	55.5
Fattening herds	51	10.6	506	10.5
Total	**482**		**4,764**	

Discussion

The results from the surveillance programme for the specific virus infections in swine give additional documentation of freedom from these infections in the Norwegian (commercial) swine population. Antibodies against any of the specified viruses have been detected only once since the start in 1994, when a low level of antibodies against swine influenza (H_3N_2) was detected in one herd in 1998. To date, there have been no clinical recordings indicating the presence of any of the viral infections included in this surveillance and control programme in Norway (1-4).

The Norwegian swine population has undergone structural changes during the last ten years. The number of herds has declined and the average herd size increased, while the produced tonnage of pork meat has been relatively stable. The number of sampled herds and animals was reduced in 1996 due to a modification of the ESA requirements to maintain the additional guarantees for AD. The EU has not approved the programmes for the other specific virus infections for granting of additional guarantees, so they are continued based on national decisions. The fraction of sampled farms has not declined significantly since the start of the programme, the values being 14.3% and 12.0% in 1994 and 2003, respectively. No wild swine population is registered in Norway. This is perhaps due to the cold winter climate, although in neighbouring Sweden, the wild swine population is growing. The geographical distribution of investigated farms is in accordance with the spatial distribution of the total swine herd population (Figure 2).

Due to low import of live swine and swine products, the Norwegian swine population is relatively isolated. In 2003 only 6 live pigs and 200 doses of swine semen were imported to Norway, following the trend from previous years. In some of the neighbouring countries which are potential trading partners for swine breeding material, some of the infectious diseases included in the programme occur. PRCV is present in Swedish swine and PRRS occur in Denmark.

Seven countries purchase breeding material from the main Norwegian swine breeding organisation, Norsvin international (www.norsvin.no), among them Australia and New Zealand. The surveillance programme provides solid documentation of the good health situation in the Norwegian pig population in general and the breeding herds in particular, making such trade possible.

References

1. Fredriksen, B., Tharaldsen, J., Krogsrud, J., 2000. Rapport for overvåkings- og kontrollprogrammet for gris i Norge 1999. (The surveillance and control programme for swine in Norway in 1999). National Veterinary Institute, Oslo, Norway.

2. Fredriksen, B., Tharaldsen, J., 2001. The surveillance and control programme on specific virus infections in Norwegian swine herds in 2000. National Veterinary Institute, Oslo, Norway.

3. Fredriksen, B., Tharaldsen, J., 2002. The surveillance and control programme for specific virus infections in swine herds in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 127-134.

4. Jarp, J., Tharaldsen, J., 2003. The surveillance and control programme for specific virus infections in swine herds in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 109-115.

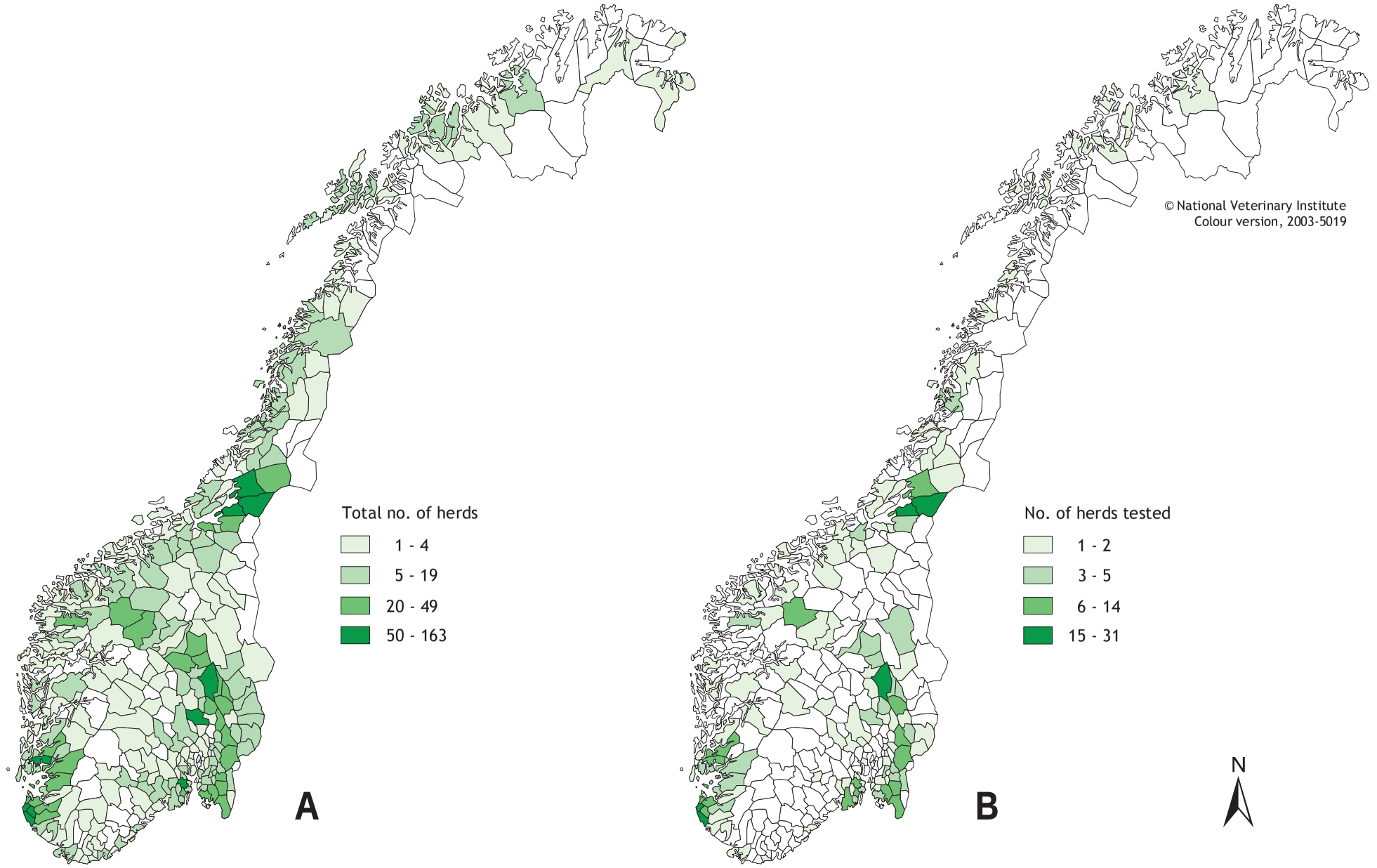


Figure 2. Geographical distribution on municipality level of the swine herd population (A), and of the herds tested in the surveillance and control programme for specific virus infections (B) in 2003.

The surveillance and control programme for infectious laryngotracheitis (ILT) and avian rhinotracheitis (ART) in poultry flocks in Norway

Annual report 2003

Berit Tafjord Heier
Jorun Tharaldsen

Veterinærinstituttet
National Veterinary Institute

Introduction

The Norwegian Animal Health Authority is responsible for the implementation of the surveillance and control programmes for infectious laryngotracheitis (ILT) and avian rhinotracheitis (ART) in poultry flocks. The programmes, which were started in 1998, are based on serological investigations. The National Veterinary Institute in Oslo (VI) is responsible for the planning, laboratory investigations and the reporting components of the programmes (1, 2).

ILT is a serious respiratory disease in chickens, which was first described in the USA in the 1920s. Since then the disease has been seen in most parts of the world, including European countries (3). ILT has not been diagnosed in commercial chicken flocks in Norway since 1971, but clinical outbreaks of ILT have occurred sporadically in Norwegian hobby flocks since 1998. ILT is categorized by the OIE as a list B-disease, whereas in Norway it is a notifiable list A-disease.

ART is a highly contagious infection which affects the upper respiratory passages of poultry. The disease is called turkey rhinothracheitis (TRT) in turkeys and swollen head syndrome (SHS) or ART in chicken. The disease is caused by avian pneumovirus (APV), and was first described in South Africa in the 1970s. Since then, the disease has been diagnosed in most countries (3). The disease spread through turkey flocks all over Great Britain during a few months in 1985 (4). ART has also been diagnosed sporadically in our neighbouring countries. ART had until 2003 never been diagnosed in Norway where it is a notifiable list B-disease. ART is not notifiable in the OIE-system.

Aim

The aim of the national surveillance and control programmes for ILT and ART is to document that the commercial poultry population in Norway is free from these infections and to contribute to the maintenance of this status.

Materials and methods

According to the national regulations for certification of poultry breeding farms (Forskrift om sertifisering av fjørfevirksomheter av 18.11.94), blood samples from 60 birds must be taken at least once a year from every breeding flock at the farms. These blood samples are to be tested for Newcastle disease. Thirty of the 60 samples from chicken and turkey flocks are included in the national surveillance and control programmes for ILT and ART. Blood samples from chickens and pheasants are tested for antibodies against both viruses, the samples from turkeys are tested only against APV. Blood samples from other poultry flocks are not included in the programme. Figure 1 shows the number of farms tested during the time period 1998-2001. Information from the Norwegian Animal Health Authority concerning farms which need to be certified in 2000, indicated that 89 broiler breeder farms, seven layer breeder farms and four turkey breeder farms should have submitted samples for investigations that year.

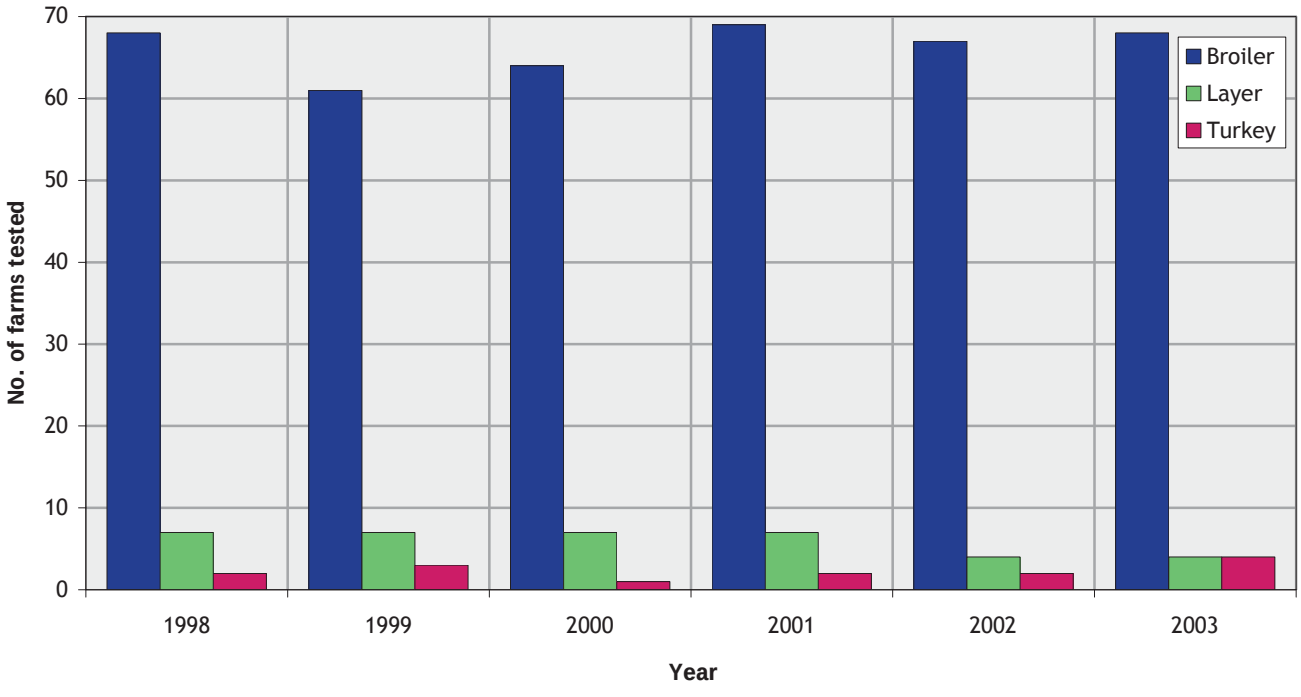


Figure 1. The number of farms tested in the surveillance and control programmes for infectious laryngotracheitis (ILT) and avian rhinotracheitis (ART) in poultry flocks in Norway during the time period 1998-2001.

Table 1. Number of farms, flocks and birds tested in the surveillance and control programmes for poultry in 2003

Production	No. of farms tested	No. of flocks tested	No. of birds tested per flock	Total no. of birds tested	Infection
Broiler	68	91	30	2,730	ILT, ART
Layer	4	11	30	330	ILT, ART
Turkey	4	5	30	150	ART
Total	**76**	**107**		**3,210**	

ILT
An indirect ELISA-test produced by Kierkegaard-Perry, Gaithersburg Maryland, USA, was used for the testing of antibodies against the ILT-virus.

ART
All serum samples were tested for specific antibodies against APV with a blocking-ELISA produced by SVANOVA, Uppsala, Sweden or an indirect ELISA produced by Guildhay Ltd, Guildford, UK.

Any serum sample with a positive reaction in the ELISA-tests is, in accordance with the programme design, to be submitted to the Veterinary Laboratories Agency (VLA), Weybridge, England for confirmation.

Results

Table 1 shows the number of farms, flocks and birds tested in the different poultry production types in the national surveillance and control programmes in 2003.

ART
Of the total 3,210 samples analysed for antibodies against APV, samples from one farm tested positive. The location situated in Rogaland housed two closely located broiler breeding flocks from which 60 samples from each flock were tested in the end of April 2003. In one flock 23 samples out of 60 tested positive in the ELISA and in the subsequent neutralisation test, nine of 30 tested samples were positive. From a new sampling two weeks later, 19 of 30 samples were positive in the ELISA test. All the 60 samples from the other flock analysed were negative, but when retesting this flock two weeks later, two samples of 30 were positive. Both flocks were stamped out. Several other poultry flocks in the area were tested serologically, but no other positive flocks were found.
All the other samples analysed in the surveillance programme were negative.

ILT
All the 3,060 blood samples were negative for antibodies against ILTV.

Discussion

ART has never been diagnosed in Norwegian poultry before the demonstration of antibodies against APV in the samples collected routinely for certification of a breeding flock located in the most dense commercial poultry area in Norway. No other commercial flocks have tested positive indicating no further spread of the infection. It is of great importance that the Norwegian commercial poultry population is maintained free of ART.

In 2003 several infectious diseases have occurred in non-commercial birds in Norway. Antibodies against ILT were found in approximately 30 hobby flocks, while an outbreak of Newcastle disease occurred in a fancy pigeon loft. It is thus of major importance that commercial poultry flocks are kept strictly isolated from hobby birds and backyard poultry flocks. The non-commercial bird populations are complex, and pose a problem for the control of the contagious poultry disease due to the difficulties associated with performing systematic disease surveillance in such bird populations.

References

1. Heier, B.T., Tharaldsen, J., 2003. The surveillance and control programmes for infectious laryngotracheitis (ILT) and avian rhinotracheitis (ART) in poultry flocks in Norway. In: Heier, B. T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 117-121.

2. Heier, B.T., Tharaldsen, J., Jarp, J., 2002. The surveillance and control programmes for infectious laryngotracheitis (ILT) and avian rhinotracheitis (ART) in poultry flocks in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 135-140.

3. Calnek, B.W., Barnes, H.J., Beard, C.W., McDougald, L.R. and Saif, Y.M. (Eds), 1997. Diseases of poultry, 10th ed. Iowa State University Press, Ames, Iowa, USA.

4. Jordan, F.T.W., Pattison, M., Alexander, D., Faragher, T., 2001. Poultry diseases, 5th ed. W.B. Saunders Company LTD, London, Great Britain.

The surveillance and control programme for *Campylobacter* in broiler flocks in Norway

Annual report 2003

Merete Hofshagen
Torkjel Bruheim

Veterinærinstituttet
National Veterinary Institute

Introduction

Campylobacteriosis is currently the most commonly reported bacterial infectious disease in the Norwegian human population. The incidence increased by 145% from 1997 to 2001. For close to half of the cases, the infection is acquired in Norway. Consumption of poultry meat purchased raw has been identified as a significant risk factor together with drinking undisinfected water, eating at barbecues, occupational exposure to animals, and eating undercooked pork (1).

The action plan regarding *Campylobacter* in Norwegian broilers was implemented in the spring of 2001. The objective is to reduce the human exposure to thermophilic *Campylobacter* (mainly *C. jejuni*, but also *C. coli*, *C. lari* and others) through Norwegian broiler meat products. The action plan is a joint effort involving several stakeholder groups from "stable-to-table". The Norwegian Zoonosis Centre developed the action plan in co-operation with the Norwegian Food Control Authority, the Municipal Food Control Authorities, the Norwegian Animal Health Authority, the National Veterinary Institute, the Norwegian Institute of Public Health, the Norwegian School of Veterinary Science, the Centre for Poultry Science, and the poultry industry. The Norwegian Zoonosis Centre coordinates the programme, and is responsible for the collection and analysis of data and dissemination of results.

The action plan consists of three parts; a surveillance programme including all Norwegian broiler flocks slaughtered before 50 days of age, a follow-up advisory service on farms with *Campylobacter* positive flocks, and surveys of broiler meat products.

The surveillance programme is described below. The results from the surveys of broiler meat products and additional material from the Norwegian action plan regarding *Campylobacter* in Norwegian broilers can be found at the website www.zoonose.no.

Materials and methods

The surveillance has been in effect since 27 April 2001. Pre-slaughter sampling of flocks is performed by the owner and consists of 10 swabs from fresh faecal droppings. The 10 swabs are pooled into two samples and submitted in transport media to the National Veterinary Institute's laboratory in Trondheim, where the samples are analysed. At the onset of the surveillance period, the samples were taken 10 to six days before slaughter. From September 2001 onwards sampling has been conducted eight to four days before slaughter. Positive flocks are slaughtered at the end of the day, and the carcasses from these flocks are either heat treated or frozen for a minimum of five weeks before being marketed. All flocks are tested again upon arrival at the slaughter plant by sampling 10 cloacal swabs per flock at the slaughter line. The 10 swabs are pooled into one sample and analysed by local laboratories. Samples are analysed using the method described in NMKL no. 119, 1990, with minor modifications.

Results and discussion

During 2003, 3,550 flocks from 509 broiler farms were tested. These flocks were slaughtered in 3,731 batches (a batch includes all chickens from one flock slaughtered at the same day). A total of 161 flocks were slaughtered in more than one batch. Most of these were slaughtered in two batches, a few were slaughtered in three or four batches.

Overall, 175 (4.9%) flocks (180 (4.8%) batches) were positive for *Campylobacter* sp. either pre-slaughter, at slaughter, or both.

Of the 175 positive flocks, 90 (51.4%) flocks tested positive pre-slaughter and were subject to sanitary measures at slaughter in order to prevent contaminated poultry from reaching the general market as fresh broiler meat. Nine flocks tested positive at pre-slaughter only.

The positive flocks came from 120 (23.6%) of the farms. Of these 120 positive farms, 87 (72.5%) had only one positive incidence during 2003 (a positive incidence is defined as one positive flock or as several parallel positive flocks from different houses) and these produced 93 (53.1%) of the positive flocks. A total of 28 (23.3%) farms had two positive incidences (producing 65 (37.1%) of the positive flocks), four (3.3%) had three and one (0.8%) had four positive incidences. The five farms with more than two positive incidences in 2003 (equals 4.2% of all positive farms in 2003) produced 17 positive flocks, which equal 9.7% of all positive flocks.

The proportion of *Campylobacter* positive flocks has varied substantially since the action plan was launched, as has the proportion of flocks that only tests positive at the slaughterhouse (Figure 1).

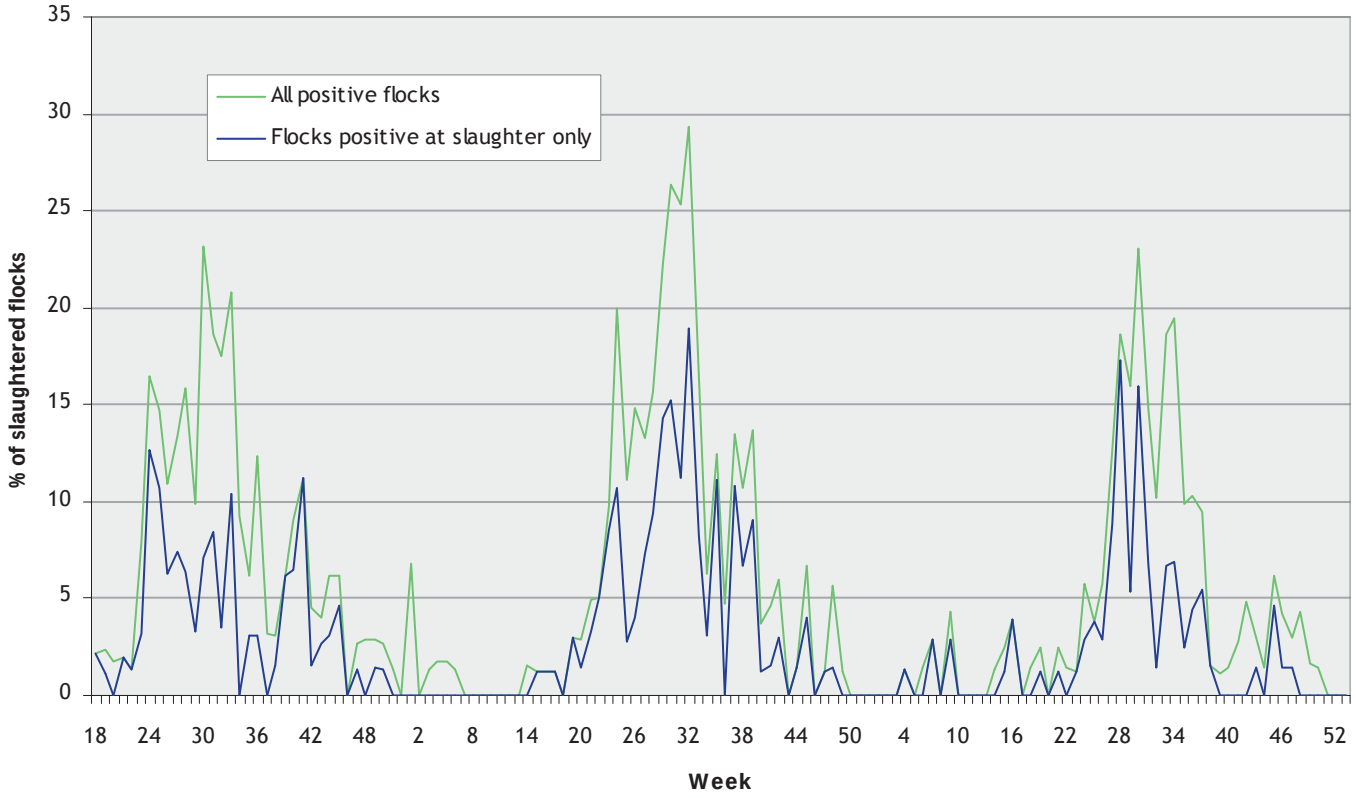


Figure 1. Weekly incidence of *Campylobacter* sp. in slaughtered Norwegian broiler flocks from week 18 in 2001 throughout 2003.

Many *Campylobacter* positive flocks fail to test positive pre-slaughter and are first discovered when the slaughterhouse samples are analysed (48.6% in 2003). A possible explanation may be that the pre-slaughter sample is taken approximately one week before slaughter. As most of the broilers are slaughtered at four – five weeks of age, a large part of their life still remains at pre-slaughter sampling. The possibility to be infected during this last week of life is therefore significant, and the pre-slaughter sample should be taken as close to slaughter as possible.

There have been problems with cross contamination between flocks, either during transport, at the slaughterhouse or at the laboratory. A total of 16 flocks were initially identified as positive, but were after thorough examinations (presence of *Campylobacter* sp. with identical AFLP-profile as another flock slaughtered the same day) categorized as representing cross contamination, and therefore classified as negative.

For the positive pre-slaughter samples, *C. jejuni* was isolated from 90%, *C. coli* from 9% and *C. lari* from 1% of the samples. For those slaughterhouse samples where the reference laboratory confirmed *Campylobacter* sp., *C. jejuni* was isolated from 92%, *C. coli* from 5% and *C. lari* from 3% of the samples. For eight (5%) of the 160 flocks that were categorized as positive at the slaughterhouse sampling, the reference laboratory could not confirm the finding of *Campylobacter* sp. due to lack of bacterial growth after the initial isolation.

For the 75 flocks where *Campylobacter* species was identified both in the pre-slaughter sample and the slaughterhouse sample, the identification differed for 5% of the flocks. These discrepancies may be explained by the presence of several clones of *Campylobacter* sp. in a flock.

Considerable regional differences in the proportions of positive flocks and farms have been revealed (Table 1, Figure 2).

Most farmers follow the guidelines regarding time of pre-slaughter sampling, i.e. eight to four days before slaughter. For 2003, a total of 188 (5.3%) flocks were sampled earlier than eight days before slaughter, mostly in connection with holidays. In total, less than 0.5% of the flocks were not sampled according to the action plan (i.e. sampled only once or not at all).

Table 1. *Campylobacter* positive flocks and farms by county in Norway 2003

	Farms			Flocks		
County	N	No. positive	(%)	N	No. positive	(%)
Østfold	84	18	(21)	591	33	(6)
Akershus	15	4	(27)	108	6	(6)
Hedmark	112	45	(40)	799	61	(8)
Oppland	10	2	(20)	55	2	(4)
Buskerud	11	0	(0)	67	0	(0)
Vestfold	40	5	(13)	257	6	(2)
Telemark	5	2	(40)	31	4	(13)
Aust-Agder	4	1	(25)	24	1	(4)
Vest-Agder	5	0	(0)	37	0	(0)
Rogaland	89	14	(16)	676	17	(3)
Hordaland	16	1	(6)	94	1	(1)
Sogn og Fjordane	1	1	(100)	7	2	(29)
Møre og Romsdal	3	1	(33)	28	1	(4)
Sør-Trøndelag	56	19	(34)	368	30	(8)
Nord-Trøndelag	58	7	(12)	408	11	(3)
Total	**509**	**120**	**(23.6)**	**3,550**	**175**	**(4.9)**

References

1. Kapperud *et al.*, 2003. Factors associated with increased and decreased risk for *Campylobacter* infection. A prospective case-control study in Norway. Am. J. Epidemiol. 158, 3.

2. Hofshagen, M., Kruse, H., Opheim, M., 2002. The surveillance and control programme for *Campylobacter* in broiler flocks in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 143-146.

3. Hofshagen, M., Kruse, H., Opheim, M., 2003. The surveillance and control programme for *Campylobacter* in broiler flocks in Norway. In: Heier, BT. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 123-128.

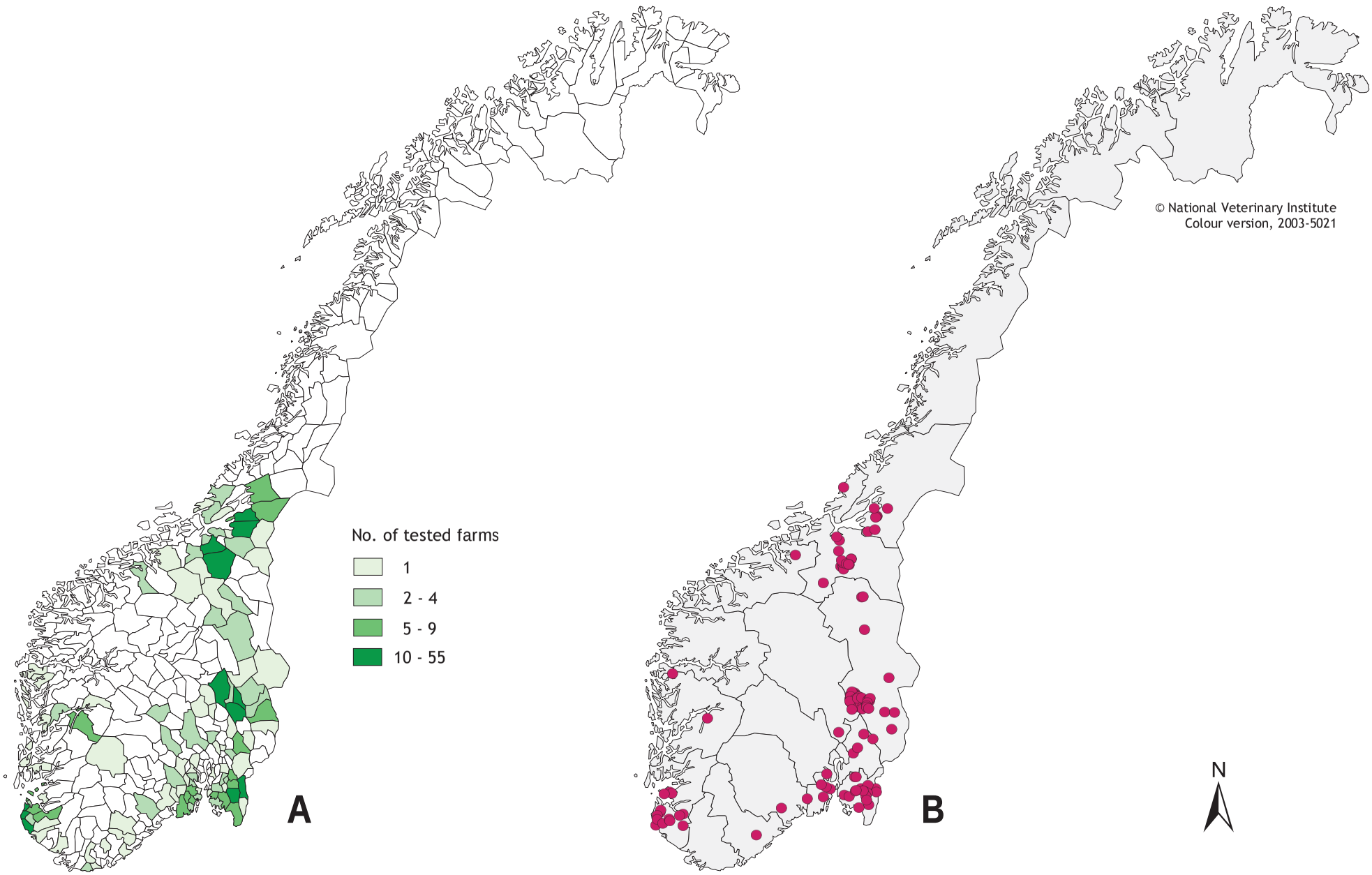


Figure 2. Geographical distribution of tested broiler farms by municipality (A), and location of farms which had one or more *Campylobacter* positive flocks (B) in 2003.

The surveillance and control programme for viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN) in Norway

Annual report 2003

Tore Håstein
Birgit Dannevig
Hege Hellberg

Veterinærinstituttet
National Veterinary Institute

Introduction

Viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN) are two important infections in salmonids caused by rhabdoviruses. The surveillance and control programme for these two diseases in Norway started in the autumn of 1994. The programme is formally run by the Norwegian Animal Health Authority which is also directly responsible for inspection and sampling. The National Veterinary Institute performs the laboratory procedures in accordance with EU Decision 2001/183/EU (repealed version of 92/532/EEC) (1) and prepares the report.

VHS occurs in continental Europe and is an important disease in rainbow trout farming due to its clinical and economic consequences.

A specific strain of VHS virus has caused disease in Pacific cod (*Gadus macrocephalus* (Tilesius)) and Pacific herring (*Clupea harengus pallasi* (Valenciennes)) (2, 3, and 4). This strain is not pathogenic to rainbow trout (*Oncorhynchus mykiss* (Walbaum)). VHS virus has been isolated from several different species of marine fish in North European coastal waters (the English Channel, the Baltic Sea, the North Sea, the Norwegian Sea, Skagerak) (2).

VHS was reported for the first time in Norway in 1964 and until 1974, several clinical disease outbreaks were diagnosed.

IHN has caused serious economic losses in farmed rainbow trout and salmon, and the disease has also had an impact on wild populations of Pacific salmon. The disease was first described in Europe in 1985, in France and Italy. The disease has been documented in several other countries in continental Europe, but has not yet been diagnosed in Norway.

Aim

The purpose of the surveillance and control programme is to maintain Norway's status as free from viral haemorrhagic septicaemia (VHS) and infectious haematopoietic necrosis (IHN).

For more detailed information on VHS and IHN, reference is made to previous reports of the surveillance and control programmes (6).

Materials and methods

Norway achieved disease free status for VHS and IHN approved by ESA on historical grounds, based on health control information and virological examinations carried out in Norwegian fish farms since 1967. Norway has operated a surveillance programme in accordance with Directive 91/67 EEC since 1994 (5).

According to Directive 91/67/EEC (5) and Decision 2001/183/EU (1), virological examinations have to be carried out in 50% of all fish farms in which species susceptible to VHS and IHN infection are kept. The samples to be examined for maintenance of VHS/IHN free status, shall contain spleen, anterior kidney, and in addition, either heart or encephalon. Under certain circumstances, ovarian fluid has to be examined (brood fish). For fry (<4 cm) the entire fish except the body behind the vent shall be examined. According to Decision 2001/183/EU, organ material from 30 fish from each farm shall be examined. Ten fish may be pooled to form a single sample. If rainbow trout are kept on a farm, all samples shall be derived from this species. In farms without rainbow trout, the samples shall be taken on an even basis from all the different species present.

The District Veterinary Officer (DVO) or the person/persons authorised to do the sampling on behalf of the DVO, collect the required material and send it to the National Veterinary Institute for analysis in accordance with an agreed sampling schedule.

The EU Decision 2001/183/EU (1) gives detailed information on how to carry out the virological examinations and the type of cells to be used in the cell culture (BF-2 and EPC or other alternatives given by the EU reference laboratory in Århus (Danish Institute of Food and Veterinary Research)). Furthermore, 2001/183/EU advises on identification of the virus, should a cytopathogenic effect develop from a given sample. Since IPN virus is ubiquitous in Norwegian fish farms, the sample material is neutralised with IPN antiserum prior to inoculation on cell cultures to avoid IPN virus masking VHS/IHN virus in the samples.

Results

In 2003, material from 498 farms was examined. Table 1 gives an overview of the distribution of sites and species examined in 2003. Table 2 shows the number of farms examined in previous years of the surveillance and control programme. Figures 1 and 2 show the geographical distribution of the number of farms by the different species examined in 2003 on a municipality level.

No cases of VHS or IHN virus were detected in 2003.

Table 1. Different categories of fish examined for VHS/IHN in 2003*

	Fry - smolt		Fish for consumption		Brood fish		Total	
	No. sites	No. of samples	No. sites	No. of samples	No. sites	No. of samples	No. sites	No. of samples
Atlantic salmon	35	1260	350	10,610	1	30	387**	11,910**
Rainbow trout	7	200	66	1,920			74**	2,150**
Brown trout	15	495	8	210	1	30	24	735
Arctic char			9	260			9	260
Turbot			1	30			1	30
Sea trout	2	50					2	50
Brook trout	1	15					1	15
Total	**60**	**2020**	**434**	**13,030**	**2**	**60**	**498**	**15,150**

* Samples received, but deemed unsuitable for examinations, are not included in the table. In total, 120 samples from 4 farms were found unsuitable in 2003 and new samples had to be taken. In total, the number of sites is different when summarizing from the columns and rows, because one site may have populations of several species and/or physiological stages.

** One sample of Atlantic salmon (*Salmo salar*) and three of rainbow trout was not marked with type of farming.

Table 2. Number of farms examined for VHS/IHN during the time period 1994-2003

Farm types	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Hatcheries	4	71	169	162	30	27	45	30	32	54
On growing farms	49	207	340	346	478	527	447	508	414	429
Brood stock farms					2	3	7	7	14	2
Farms with Atlantic salmon	52	225	425	392	417	462	382	408	372	387
Farms with rainbow trout		31	63	69	66	62	83	93	61	74
Farms with brown trout		15	13	38	21	27	28	24	23	24
Farms with char		1	7	6	5	4	10	8	9	9
Farms with turbot	1	6	1	1		1	1	4		1
Farms with sea trout					2	3	2	4	1	2
Farms with brook trout					2		1	1	2	1
Farms with grayling					1					
Total	**53**	**278**	**509**	**506**	**510**	**554**	**494**	**534**	**468**	**498**

Discussion

According to the specifications of Decision 2001/183/EU, the samples must be kept cool during transport; the temperature shall not exceed 10ºC. Ice should still be present in the transport box upon arrival at the laboratory or one or more freeze blocks should still be partly or completely frozen. In occasional cases, some samples had to be discarded as unsuitable for examination and new samples had to be collected. The main reason for this was delayed transport from the sampling location to the laboratory.

Conclusion

No suspected or confirmed cases of VHS virus or IHN virus have been registered in Norwegian fish farms in 2003, based on the examinations carried out in the surveillance and control programme for VHS and IHN at the National Veterinary Institute.

References

1. Commission Decision 2001/183/EU laying down the sampling plans and diagnostic methods for the detection and confirmation of certain fish diseases repealing Decision 96/532/EEC.

2. OIE International Aquatic Animal Health Code and Diagnostic Manual for Aquatic Animal Diseases 2000.

3. Kocan, R., Bradley, M., Elder, N., Meyers, T., Batts, W., Winton, J., 1995. North American strain of viral haemorrhagic septicaemia virus is highly pathogenic for laboratory reared Pacific herring. J. Aquat. Animal Health 9, 279-290.

4. Meyers, T., Winton, J., 1995. Viral haemorrhagic septicaemia virus in North America. Annual Review of Fish Dis. 5, 3-24.

5. Council Directive 91/67/EEC concerning the health conditions governing the placing on the market of aquaculture animals and products.

6. Håstein, T., Dannevig, B., Heier, B.T., 2002. The surveillance and control programme for viral haemorrhagic septicaemia (VHS) and infectious haematopoetic necrosis (IHN) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 147-154.

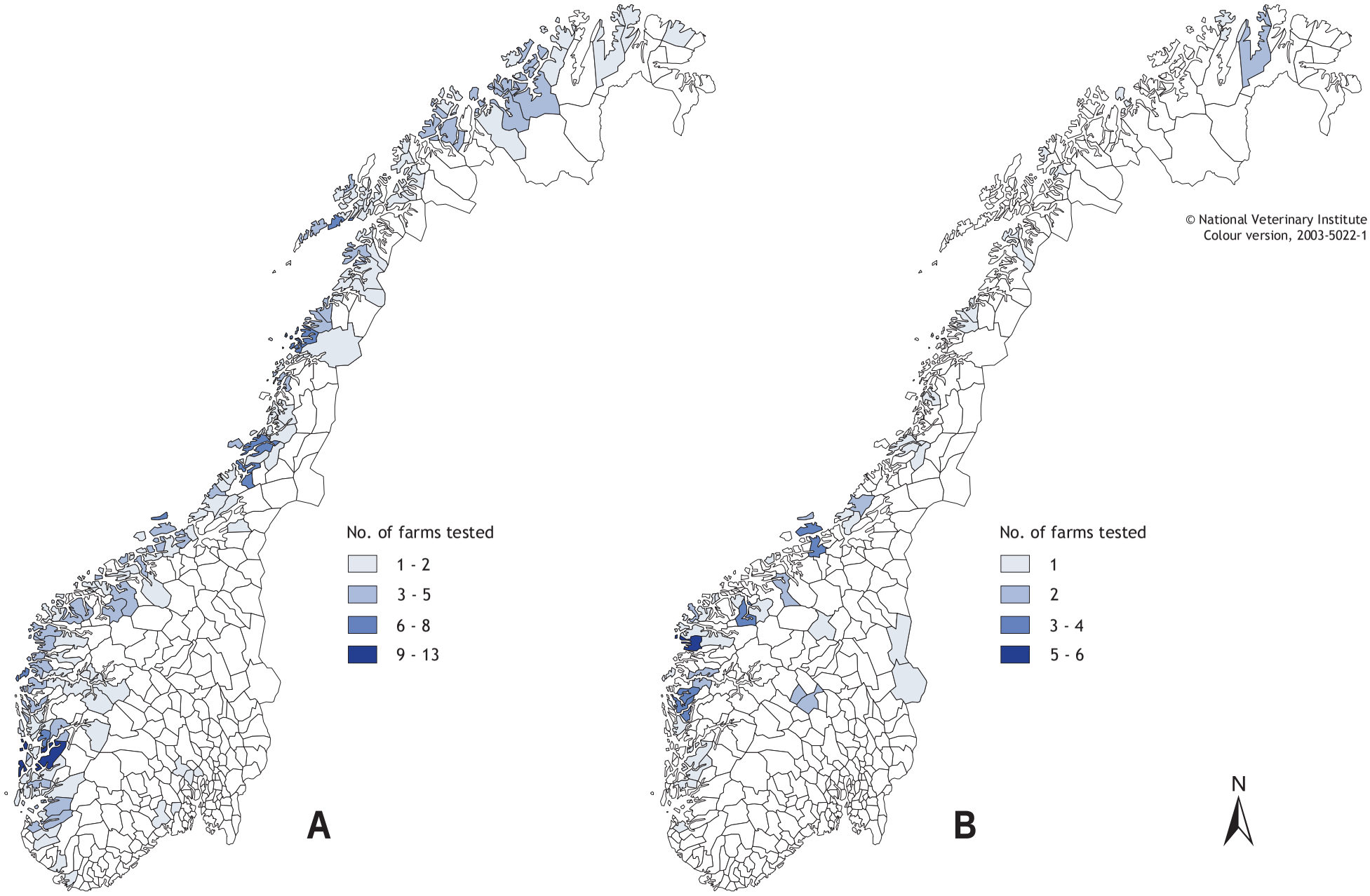


Figure 1. Geographical location on municipality level of the tested farms with Atlantic salmon (A), and with Rainbow trout (B) in the surveillance and control programme for VHS and IHN in 2003.

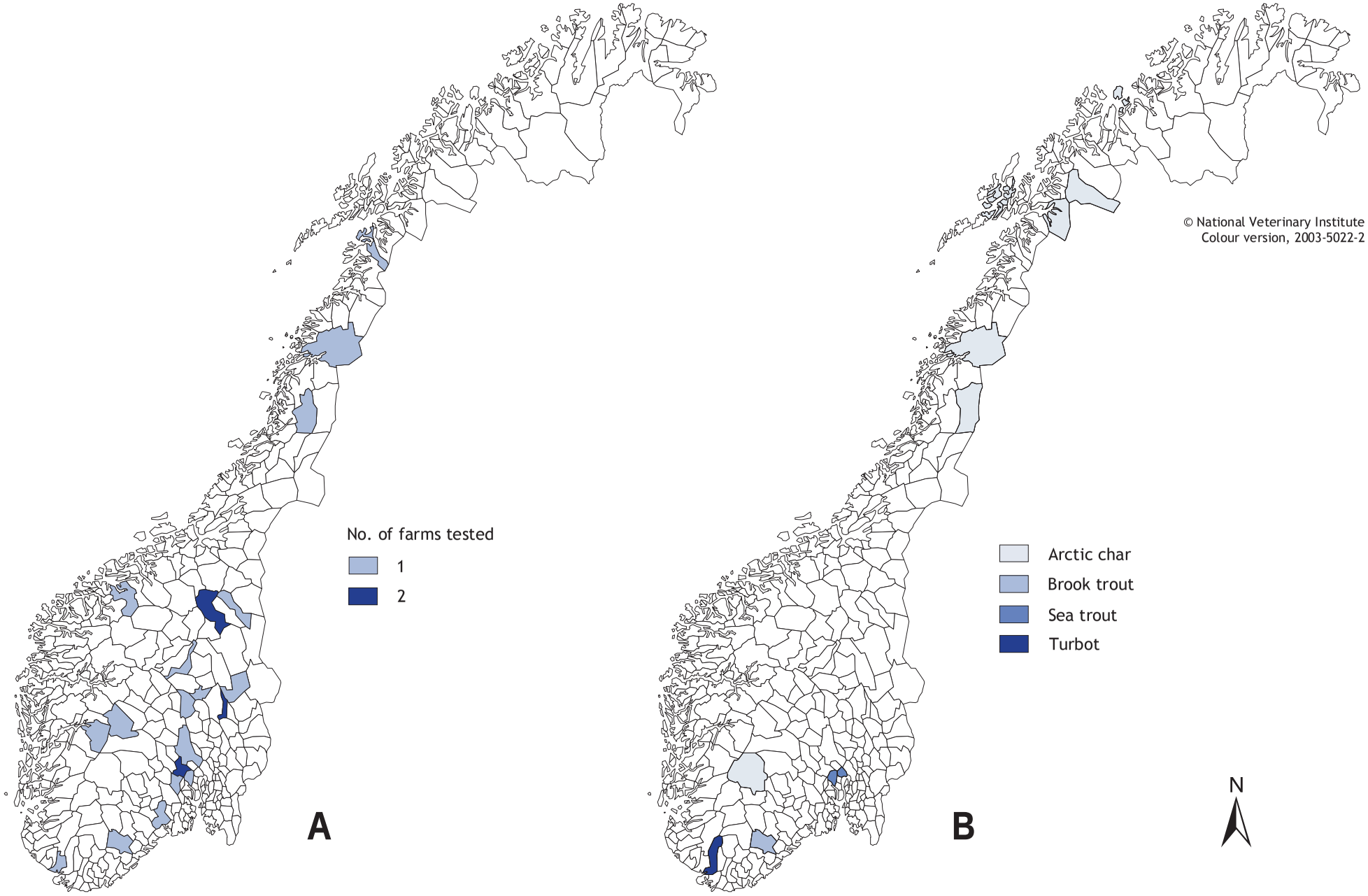


Figure 2. Geographical location on municipality level of the tested farms with Brown trout (A), and with other species (B) in the surveillance and control programme for VHS and IHN in 2003.

The surveillance and control programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway

Annual report 2003

Tor Atle Mo
Kari Norheim

Veterinærinstituttet
National Veterinary Institute

Introduction

Gyrodactylus salaris was detected for the first time in Norway in Atlantic salmon (*Salmo salar* L.) parr from a hatchery in Sunndalsøra, Møre og Romsdal County in 1975. Later the same year, *G. salaris* was detected in the river Lakselva in Misvær, Nordland County. Altogether, the parasite has been detected in Atlantic salmon fingerlings/parr from 45 rivers, 13 hatcheries/farms with Atlantic salmon parr/smolts and 26 hatcheries/farms with rainbow trout (*Oncorhynchus mykiss*) during the period 1975 to 2003. The policy of the Environmental and Veterinary Authorities is to eradicate *G. salaris* from infected rivers and farms. The procedure is aimed at eliminating the hosts (salmon and rainbow trout) and thus also the parasite, which does not have specialized free-living stages or intermediate hosts. By 31 December 2003, *G. salaris* was confirmed eradicated from 16 rivers and from all hatcheries/fish farms. For five additional rivers the result of the eradication procedure has not yet been confirmed. The parasite is known to be present in 24 rivers in Norway.

G. salaris has been a notifiable (Group B) disease in Norway since 1983, while the disease has been listed as an "Other significant disease" in the Office International des Epizooties (OIE). The Directorate for Nature Management and the County Governor Environmental Department started surveillance of *G. salaris* in Norwegian salmon rivers during the late 1970s. By the mid 1980s, the National Veterinary Institute extended this surveillance to include fish farms, especially inland rainbow trout farms. During the 1990s the Veterinary Authorities gradually undertook the responsibility for all surveillance, and in 2000 a national surveillance programme was implemented by the Norwegian Animal Health Authority (1, 2). In 2003 the programme was carried out accordingly for most selected rivers, and in many hatcheries and farms, mainly in coordination with the surveillance and control programme for VHS and IHN.

The Norwegian Animal Health Authority (by 1 January 2004 included in the Norwegian Food Authority) is responsible for sampling rivers and fish farms. The Regional Veterinary Officers (by 1 January 2004 included in the Regional Food Authority) have, however, commissioned the respective County Environmental Departments and other institutions/companies to perform river sampling. The National Veterinary Institute is recognized as the OIE reference laboratory for the disease, and is responsible for examination of samples as well as taxonomical studies if *Gyrodactylus* is detected.

Aim

The purpose of the surveillance programme is to trace any spread of *Gyrodactylus salaris* to new river systems or fish farms. Resources are not being used to carry out surveillance in rivers and fish farms already infected, unless measures for eradication of the parasite have been carried out or other circumstances justify surveillance.

Materials and methods

The surveillance programme is based on sampling and examination procedures developed by the National Veterinary Institute. In rivers, at least 30 Atlantic salmon fingerlings/parr/smolts are caught by means of electrical fishing gear. (It may be difficult in some rivers to sample this number of fish). The fish are killed and preserved in 96% ethanol. The samples are sent to the National Veterinary Institute in Harstad where body surface and fins are examined by a magnifying microscope (10 - 15 times magnification). Fish from farms are caught by net and samples preserved and transported to the laboratory for examination as indicated above. However, only fins (with the exception of adipose fin) are sampled and preserved for examination from fish 15 cm or more.

Results

Tables 1 and 2 show the results following examination of fish from different rivers and different fish farms, respectively. Even though the surveillance programme in the rivers focuses on Atlantic salmon, other fish species from some rivers are also included. This is mainly done to investigate further spread within a river-system or the infectious status in species regarded as good carriers for *G. salaris,* mainly char (*Salvelinus alpinus*). In some of the rivers, sampling was done at different dates and at different sampling stations. Altogether, 4,489 fish specimens from 126 rivers were examined in 2003.

Table 1. Rivers examined for *Gyrodactylus salaris* in 2003

				Detection of *Gyrodactylus*		
County	**No. of rivers sampled**	**Species examined**	**Total no. of specimens**	**Result**	**Fish species**	**River**
Finnmark	9	Atlantic salmon (*Salmo salar*)	420	Negative		
Troms	11	Atlantic salmon Arctic char (*Salvelinus alpinus*) Brown trout (*Salmo trutta*)	351	Negative		
Nordland	20	Atlantic salmon	650	*G. salaris*	Atlantic salmon	Hundåla[1]
Nord-Trøndelag	16	Atlantic salmon	617	*Gyrodactylus* sp.	Atlantic salmon	Levangerelva, Stjørdalselva
Sør-Trøndelag	5	Atlantic salmon	134	*Gyrodactylus* sp.	Atlantic salmon	Orkla
Møre og Romsdal	23	Atlantic salmon,	718	*G. salaris*	Atlantic salmon	Skorgeelva[2]
Sogn og Fjordane	19	Atlantic salmon	800	Negative		
Hordaland	5	Atlantic salmon	155	Negative		
Rogaland	2	Atlantic salmon	68	Negative		
Vest-Agder	2	Atlantic salmon	73	Negative		
Aust-Agder	1	Atlantic salmon	31	Negative		
Telemark	1	Atlantic salmon	32	Negative		
Vestfold	3	Atlantic salmon	126	*G. salaris*	Atlantic salmon	Vesleelva[3] (Sandeelva)
Buskerud	2	Atlantic salmon	61	*G. derjavini*	Atlantic salmon	Åroselva
Akershus	4	Atlantic salmon	123	*G. derjavini*	Atlantic salmon	Gjersjøelva, Sandvikselva, Askerelva Lysakerelva
Oslo	1	Atlantic salmon	30	*G. derjavini*	Atlantic salmon	Akerselva
Østfold	2	Atlantic salmon	100	Negative		
Total	**126**		**4,489**			

[1] Confirmation of previously observed infection.
[2] Expected reintroduction from infected river closely located.
[3] First observation.

G. salaris was detected in one new river; Vesleelva, a tributary of the Sandeelva, in Buskerud County. Vesleelva most likely became infected through salmon smolts migrating in brackish water from Drammenselva or Lierelva in a closely located fjord. Altogether, 2,598 fish specimens from 86 fish farms were examined in 2003 without any observation of *G. salaris*.

Table 2. Fish farms examined for *Gyrodactylus* in 2003

County	Farms	Species	No. of fish examined	Detections
Finnmark	1	Atlantic salmon	32	0
Nordland	5	Atlantic salmon	137	0
Nord-Trøndelag	13	Atlantic salmon, rainbow trout	394	0
Sør-Trøndelag	18	Atlantic salmon, rainbow trout	544	0
Møre og Romsdal	18	Atlantic salmon, rainbow trout	544	0
Sogn og Fjordane	6	Atlantic salmon	188	0
Hordaland	13	Atlantic salmon, rainbow trout	396	0
Telemark	1	Atlantic salmon	30	0
Vestfold	1	Atlantic salmon	36	0
Buskerud	2	Atlantic salmon	60	0
Oppland	6	Rainbow trout	177	0
Hedmark	2	Rainbow trout	60	0
Total	**86**		**2,598**	**0**

Conclusion

In 2003, *Gyrodactylus salaris* was detected in Atlantic salmon parr in one new river (Vesleelva in Sandeelva, Buskerud county), but no fish farms. The route of infection to Vesleelva was most likely via movement of infected salmon smolts migrating in brackish water from Drammenselva or Lierelva in a closely located fjord.

References

1. Mo, T.A., Nordheim, K., 2002. The surveillance and control programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 155-159.

2. Mo, T.A., Nordheim, K., 2003. The surveillance and control programme for *Gyrodactylus salaris* in Atlantic salmon and rainbow trout in Norway. In: Heier, B.T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 137-141.

The surveillance and control programme for viral nervous necrosis (VNN) in Norway

Annual report 2003

Hege Hellberg
Birgit Dannevig

Veterinærinstituttet
National Veterinary Institute

Introduction

Viral nervous necrosis (VNN) also known as viral encephalopathy and retinopathy (VER) is an infectious disease causing large losses of larvae and juveniles in several farmed marine fish species. The disease is caused by a betanodavirus and was initially described in *Oplegnathus fasciatus* (Krøyer) in Japan in 1990 (1). In European fish farming, VNN has been diagnosed in sea bass (*Dicentrarchus labrax* L.), sea bream (*Sparus aurata* L.), halibut (*Hippoglossus hippoglossus* L.), turbot (*Scophthalmus maximus* L.), cod (*Gadus morhua* L.) and Dover sole (*Solea solea* L.) (2). In Norway VNN was diagnosed in turbot in 1991 (3) and in halibut in 1995 (4). VNN is classified as a "significant disease" by the OIE and is a notifiable disease in Norway (group B).

The surveillance and control programme was initiated on 1 January 1999. VNN mainly affects larvae and juveniles and is easily spread by movement of infected fish. Hatcheries producing susceptible marine fish species for further distribution are the targets of surveillance. Larvae and juveniles are screened by reverse-transcriptase polymerase chain reaction (RT-PCR) (5, 6). Detection of betanodavirus genomic material leads to further investigations utilising a wider range of methods.

The programme is formally run by the Norwegian Animal Health Authority which is also directly responsible for inspection and sampling. The National Veterinary Institute is in charge of analysis in accordance with OIE procedures (5) and prepares the report. VNN was detected in halibut larvae in 1999, 2001 and 2002 (7).

Aim

The goal of the programme is to collect information on the occurrence of betanodavirus and VNN in susceptible farmed marine fish species in Norway and to provide information for future control measures.

Materials and Methods

Sampling

Hatcheries producing halibut, turbot and cod were sampled once during 2003 (Table 1). In addition, an Icelandic hatchery is included in the programme as it exports halibut larvae to Norway. The Norwegian Animal Health Authority accepts the addition of the Icelandic hatchery to the programme.

Halibut were sampled during or around metamorphosis, while cod were sampled at startfeeding. District Veterinary Officers or persons appointed by the District Veterinary Officers, collected all the samples.

A minimum of 30 larvae or juveniles of each species were sampled from each hatchery with a minimum of five fish from each unit. Individuals showing signs of clinical disease and units exhibiting increased mortality or low growth rate were obligatorily sampled. The fish were shipped live, or tissue samples were sent in transport media e.g. RNAlater, to the National Veterinary Institute by mail.

Analysis

On arrival at the National Veterinary Institute, tissue samples were collected (entire larvae or head from larger fish), and pooled into groups of 10, giving three pooled samples from each consignment. Pooled samples were frozen and stored at - 80°C. Frozen specimens were homogenized and total RNA isolated using RNeasy MINI KIT™ (8). Reverse transcription and DNA amplification were carried out in a single tube using Qiagen OneStep RT-PCR™, 0,5 µg total RNA, 15 µM of the forward primer 5'-GGT-ATG-TCG-AGA-ATC-GCC-C-3' and 15 µM of the reverse primer 5'-TAA-CCA-CCG-CCC-GTG-TTT-3'. Reverse transcription was done at 50°C for 30 minutes, followed by denaturation at 95°C for 15 minutes. DNA amplification was performed using 34 cycles (94°C for 45 seconds, 54°C for 45 seconds and 72°C for 1 minute) and ended at 72°C for 10 minutes. PCR products were visualized by gel electrophoresis.

Results are termed positive when two or more pooled samples from each consignment are positive. If only one pooled sample is positive, RNA isolation is repeated from stored samples and RT-PCR repeated.

Results

Table 1. Results from the VNN surveillance and control programme in 2003

County/country	Hatchery	Species	No. of samples	Result
Vest-Agder	B	Halibut	30	Negative
Rogaland	Z	Cod	30	Negative
	Æ	Halibut	30	Negative
Hordaland	C	Cod	30	Negative
	D	Halibut	30	Negative
	F	Halibut	30	Negative
Sogn og Fjordane	Q	Cod	30	Negative
	Ø	Cod	30	Negative
Møre og Romsdal	H	Halibut	30	Negative
	I	Halibut	30	Negative
	K	Cod	30	Negative
	O	Halibut	30	Negative
	S	Halibut	30	Negative
	Å	Cod	30	Negative
Sør-Trøndelag	Ω	Cod	30	Negative
Nordland	W	Cod	30	Negative
	T	Cod	30	Negative
	T	Halibut	30	Negative
Troms	M	Cod	30	Negative
	U	Cod	30	Negative
Iceland	P	Halibut	30	Negative
	P	Halibut	30	Negative
	P	Halibut	30	Negative
Total			**690**	

Discussion

For 2003, the surveillance and control programme received samples from 20 hatcheries, i.e. a decrease from 23 in 2002 despite the inclusion of four hatcheries new to the programme (Æ, Ø, Å and Ω). In 2000, all hatcheries producing halibut and turbot were included, a total of 14. Cod was first represented in 2001 (9). This variation in the number of hatcheries reflects, to a certain extent the activity in the industry. Although some units may not be in production every year, there were several hatcheries in production in 2003 from which the programme did not receive samples.

In 2002, primers based on the sequence of the coat protein of Atlantic halibut nodavirus (6) were used. These primers may not be optimal for detection of nodavirus in other species, such as cod and turbot. During investigation of an outbreak of VNN in turbot in December 2002, RT-PCR using the Atlantic halibut primers gave negative results, while primers based on conserved regions of RNA2 from several species were used successfully for detection of nodavirus. These primers were therefore used in 2003 to ensure detection of nodavirus in the species included in the programme.

The goal of the programme is to collect information on the occurrence of betanodavirus and VNN in susceptible farmed marine fish species in Norway and to provide information for future control measures. This goal has not been fully achieved, the major reason being the lack of updated lists of hatcheries producing marine fish species and failure to sample all hatcheries in production. The surveillance programme will not be continued in 2004, due to harmonization of national legislation with EU legislation. The results from the 5 year survey, with a decrease in positive samples from 1999 to 2003, indicate that the hatcheries have become more adept at handling and preventing infections with nodavirus during the early stages of culture.

References

1. Yoshikoshi, K., Inoue, K., 1990. Viral nervous necrosis in hatchery-reared larvae and juveniles of Japanese parrotfish, *Oplegnathus fasciatus* (Temminck & Schlegel). J. Fish. Dis. 13, 69-77.

2. Starkey, W.G., Ireland, J.H., Muir, K.F., Jenkins, M.E., Roy, W.J., Richards, R.H., Ferguson, H.W., 2001. Nodavirus infection in Atlantic cod and Dover sole in the UK. Vet. Rec. 149, 179-181.

3. Bloch, B., Graveningen, K., Larsen, J.L., 1991. Encephalomyelitis among turbot associated with a picornavirus-like agent. Dis. Aquat. Org. 10, 65-70.

4. Grotmol, S., Totland, G.K., Kvellestad, A., Olsen, A.B., 1995. Mass mortality of larval and juvenile hatchery-reared halibut (*Hippoglossus hippoglossus* L.) associated with the presence of virus-like particles in vacuolated lesions in the central nervous system and retina. Bull. Eur. Ass. Fish Pathol. 15, 176-178.

5. OIE Manual of diagnostic tests for Aquatic animals 2003 (VER, Diagnostic procedures).

6. Grotmol, S., Nerland, A.H., Biering, E., Totland, G.K., Nishizawa, T., 2000. Characterisation of the capsid protein gene from a nodavirus strain affecting the Atlantic halibut *Hippoglossus hippoglossus* and design of an optimal reverse-transcriptase polymerase chain reaction (RT-PCR) detection assay. Dis. Aquat. Org. 39, 79-88.

7. Hellberg, H., Dannevig, B., 2003. The surveillance and control programme for viral nervous necrosis (VNN) in Norway. In: Heier, B. T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 145-149.

8. Johansen, R., Ranheim, T., Hansen, M.K., Taksdal, T, Totland, G.K., 2002. Pathological changes in juvenile halibut *Hippoglossus hippoglossus* persistently infected with nodavirus. Dis. Aquat. Org. 50, 161-169.

9. Hellberg, H., 2002. The surveillance and control programme for viral nervous necrosis (VNN) in Norway. In: Fredriksen, B., Mørk, T. (Eds), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2001. National Veterinary Institute, Oslo, Norway, pp. 161-167.

The surveillance and control programme for the nematode *Anguillicola* spp. in eel *(Anguilla anguilla)* in Norway

Annual report 2003

Erik Sterud

Veterinærinstituttet
National Veterinary Institute

Introduction

Nematodes of the genus *Anguillicola* have been accidentally imported to Europe through import of live Asian eel (*Anguillicola japonica*) (1). The European eel (*Anguilla anguilla*) is very susceptible to these parasites and severe mortality has been documented, mainly in farmed eel, but also in wild eel populations. Two species of *Anguillicola* have been reported from Europe. Mainly *A. crassus*, although *A. novaezelandiae* has been identified in one case in Italy. *Anguillicola* spp. cause disease in eel only, but use several obligate or paratenic intermediate hosts in their life cycle. Several crustacean copepods are potential intermediate hosts (2, 3, 4, 5). Several fish species are potential paratenic hosts (3, 6, 7, 8). Anguillicoliosis is a disease that leads to reduced activity, reduced growth, and in severe cases, the death of the host. Pathological changes are limited to the swim bladder (9).

Eel farming is based on wild-caught elvers (migrating juvenile eels) for subsequent ongrowing in farms. Limited natural resources make import of elvers to Norway a likely occurrence. These fish may carry *Anguillicola* spp.

Anguillicola crassus has previously been found in Norwegian eel farms in 1993 (10) and probably in 1997 (unpublished observations). These farms, no longer in existence, based their production on wild eel caught along the Norwegian coast. It is therefore possible that *A. crassus* is established in the Norwegian fauna. If so, the parasite may have spread to Norway from Sweden, although it is also possible that the parasite has been introduced through local unregistered imports. The parasite has however, never been found in wild eel populations in Norway, although no systematic search has so far been performed.

Aim

The purpose of the surveillance and control programme is to reveal infection with *Anguillicola* spp. in farmed eel in Norway and to provide information for future control measures.

Material and methods

According to the surveillance and control programme, all Norwegian eel farms should be sampled twice per year for the presence of *Anguillicola* spp. in their stocks. The Norwegian Animal Health Authority is responsible for sampling through District Veterinary Officers. The National Veterinary Institute is responsible for the examination of the samples. The investigation comprises visual examination of the swim-bladder for the presence of *Anguillicola* in 30 eels.

Results

One farm was controlled 2003. Thirty eels were examined, all with negative results regarding *Anguillicola* spp.

Conclusion

No cases of *Anguillicola* spp. infection were diagnosed through the surveillance and control programme in 2003.

References

1. Køie, M.,1991. Swimbladder nematodes (*Anguillicola* spp.) and gill monogeneans (*Pseudodactylogyrus* spp.) parasitic on the European eel (*Anguilla anguilla*). J. Cons. Int. Explor. Mer. 47, 391-398.

2. Petter, A.J., Fontaine, Y.A., Le Belle, N., 1989. Etude du dévelopement larvaire de *Anguillicola crassus* (Dracunculoidea, Nematoda) chez un cyclopidae de la région Parisienne (Study of the larval development of *Anguillicola crassus* (Dracunculoidea, Nematoda) in a cyclopidae of the Paris area). Ann. Parasitol. Hum. Comp. 64, 347-355.

3. Petter, A.J., Cassone, J., Le Belle, N., 1990. Observations sur la biologie des premiers stades larvaires d'*Anguillicola crassus*, nematode parasite d'anguille (Observations on the biology of the first larval stages of *Anguillicola crassus,* an eel parasitic nematode). Ann. Parasitol. Hum. Comp. 65, 28-31.

4. De Charleroy, D., Grisez, L., Thomas, K., Belpaire, C., Ollevier, F., 1990. The life cycle of *Anguillicola crassus*. Dis. Aquat. Org. 8, 77-84.

5. Kennedy, C.R., Fitch, D.J., 1990. Colonization, larval survival and epidemiology of the nematode *Anguillicola crassus*, parasitic in eel, *Anguilla anguilla*, in Britain. J. Fish Biol. 36, 117-131.

6. Haenen, O.L.M., van Banning, P., 1990. Detection of larvae of *Anguillicola crassus* (an eel swimbladder nematode) in freshwater fish species. Aquaculture. 87, 103-109.

7. Höglund, J., Thomas, K., 1992. The black goby *Gobius niger* as a potential paratenic host for the parasitic nematode *Anguillicola crassus* in a thermal effluent of the Baltic. Dis. Aquat. Org. 13, 175-180.

8. Székely, Cs., 1994. Paratenic hosts for the parasitic nematode *Anguillicola crassus* in Lake Balaton, Hungary. Dis. Aquat. Org. 18, 11-20.

9. Egusa, S., 1979. Notes on the culture of the European eel (*Anguilla anguilla* L.) in Japanese eel-farming ponds. In: Thurow, F. (Ed), Eel Research and Management. Rapp. Proc. Verb. Reún. Cons. Int. Exp. Mer. 174, 51-58.

10. Mo, T.A., Steien, S.H., 1994. First observation of the eel swimbladder nematode *Anguillicola crasus* in Norway. Bull. Eur. Ass. Fish. Pathol. 14, 163-4.

The surveillance and control programme for bonamiosis and marteiliosis in European flat oysters *(Ostrea edulis* L.*)* in Norway

Annual report 2003

Hege Hellberg

Veterinærinstituttet
National Veterinary Institute

Introduction

Notifiable diseases have not been reported from any European flat oyster (*Ostrea edulis* L.) populations in Norwegian waters (1, 2). This is in contrast to the situation in most other oyster producing European countries, where infectious diseases cause great losses in previously highly productive flat oyster populations (3). The protozoan parasites *Bonamia ostreae* and *Marteilia refringens* are identified as the main disease-causing organisms (4, 5) and bonamiosis has caused a collapse in flat oyster production in affected regions. Bonamiosis and marteiliosis are classified as notifiable diseases by the OIE and as group A diseases in Norway.

The surveillance and control programme for bonamiosis and marteiliosis was initiated in the fall of 1995. The programme is based on directions given by Commission Decision of 16 May 1994, 94/306/EC, describing procedures for sampling and analysis of European flat oysters for bonamiosis and marteiliosis (6). The European flat oyster is found to latitude 65°N in Norway, and wild populations are small and geographically limited due to climatic conditions. Eight sampling sites along the Norwegian coast have been selected (Figure 1). Selection was based on the geographical distribution and size of wild populations, and the structure of the oyster industry.

The Norwegian Animal Health Authority is in charge of the programme, and responsible for inspection and sampling. The National Veterinary Institute in Bergen is in charge of laboratory procedures and analysis in accordance with the EU Decision, and also prepares the reports. A total of 4,810 oysters were examined during the initial two-year control period 1995-1997. *Bonamia* sp. or *Marteilia refringens* were not observed. During the following four years to 31 December 2001, a total of 2,430 oysters were examined and *Bonamia* sp. or *Marteilia refringens* were not observed. During 2002, the National Veterinary Institute in Bergen received a total of 420 oysters from 8 sites, 240 of these were examined in 2002. *Bonamia* sp. or *Marteilia refringens* were not observed (7). Remaining samples from 2002 were examined in 2003 (Table 1).

Aim

The goal of the programme is to document the absence of *Bonamia ostreae* and *Marteilia refringens* in Norwegian flat oysters and obtain approved zone status for Norway.

Material and methods

Sampling

The sample sites are inspected and oysters sampled in the spring and autumn of each year by District Veterinary Officers, or persons appointed by the District Veterinary Officers. During the initial two-year period from 1995 to 1997, 150 oysters were sampled each spring and autumn at each site. From 1998 onwards, 30 oysters per site have been collected each spring and autumn. Live oysters are shipped to the National Veterinary Institute in Bergen.

Analysis

Oyster shipments arrive at the laboratory within 24 hours of sampling. The oysters are opened and sampled for histological examination according to section 5.2 of Commission Decision of 16 May 1994, 94/306/EC. Tissue samples are fixed in Davidson's fixative for at least four days. The samples are dehydrated through an ascending ethanol series, embedded in paraffin and sectioned with a Reichert-Jung 2035 microtome. Sections (3-5 µm) are mounted on glass slides, stained with Haemotoxylin-Eosin in a SHANDON VARISTAIN 24, a coverslip applied and fastened with Eukitt. Two sections of each sample are prepared and examined in a Leitz Laborlux S or a Leica DM LB microscope at magnifications ranging from 100x to 1,000x. Samples may be stored for weeks in Davidson's fixative prior to processing and can be stored indefinitely when embedded in paraffin or on covered glass slides prior to analysis.

Results

During 2003, the National Veterinary Institute in Bergen received a total of 480 oysters from eight sites (Table 1, Figure 1). All samples were examined. *Bonamia* sp. or *Marteilia refringens* were not observed. In addition, 180 samples from autumn 2002 were examined. *Bonamia* sp. or *Marteilia refringens* were not observed.

Table 1. Number of sample sites tested for bonamiosis and marteiliosis in 2003 and autumn 2002

Sample site	Autumn 2002	Spring 2003	Autumn 2003	Total 2003
1	30	30	30	60
3	*	30	30	60
4	30	30	30	60
5	30	30	30	60
6	30	30	30	60
7	*	30	30	60
8	30	30	30	60
9	30	30	30	60
Total: 8	**180**	**240**	**240**	**480**

* =Not sampled

Discussion

The results from the initial two-year period provide support for freedom from bonamiosis and marteiliosis in the Norwegian flat oyster population. Given a sample size of 150, the surveillance and control programme is designed to detect infected oysters at a prevalence of 2% or higher at a 95% confidence level. For subsequent samplings, a sample size of 30 gives a 95% probability for detection of a 10% prevalence of infected individuals.

Oyster production in Norway is limited and the present sampling programme covers the geographical area in which commercial production and harvesting is possible. Sampling is judged to be representative and the results from the continued surveillance support the findings that *Bonamia ostreae* and *Marteilia refringens* are not present in the Norwegian flat oyster population.

References

1. Mortensen, S.H., 1993. A health survey of selected stocks of commercially exploited Norwegian bivalve molluscs. Dis. Aquat. Org. 16, 149-156.

2. Hellberg, H., Mortensen, S.H., Hernar, I., Knutsen, G.H., 2002. Resultater fra overvåknings- og kontrollprogrammet for parasittene *Bonamia ostreae* og *Marteilia refringens* i norske bestander av europeisk flatøsters (*Ostrea edulis* L.) (Results from the surveillance and control programme for the parasites *Bonamia ostreae* and *Marteilia refringens* in Norwegian populations of European flat oysters (*Ostrea edulis* L.)). Nor. Vet. Tidsskr. 114, 13-17.

3. Steins, N.A., 1997. *Ostrea edulis* in crisis, ESSFIN Concerted Action Workshop 2 Northern Waters, Aarhus, Denmark.

4. Grizel, H., 1979. *Marteilia refringens* and oyster disease - recent observations. Mar. Fish Rev. 41, 38-39.

5. Pichot, Y., Comps, M., Tige, G., Grizel H, Rabouin, M-A., 1981. Recherches sur *Bonamia ostreae* gen. n., sp. n., parasite nouveau de l'huitre plate *Ostrea edulis* (Studies on *Bonamia ostreae* gen. n., sp. n., a new parasite of the European flat oyster, *Ostrea edulis*.) L. Rev. Trav. Inst. Pêches Marit. 43, 131-140.

6. Commission Decision 94/306/EC, 1994. Sampling plans and diagnostic methods for the detection and confirmation of certain mollusc diseases. Off. J. Eur. Comm. 133, 512-553.

7. Hellberg, H., 2003. The surveillance and control programme for bonamiosis and marteiliosis in European flat oysters (*Ostrea edulis* L.) in Norway. In: Heier, B. T. (Ed), Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2002. National Veterinary Institute, Oslo, Norway, pp. 161-164.

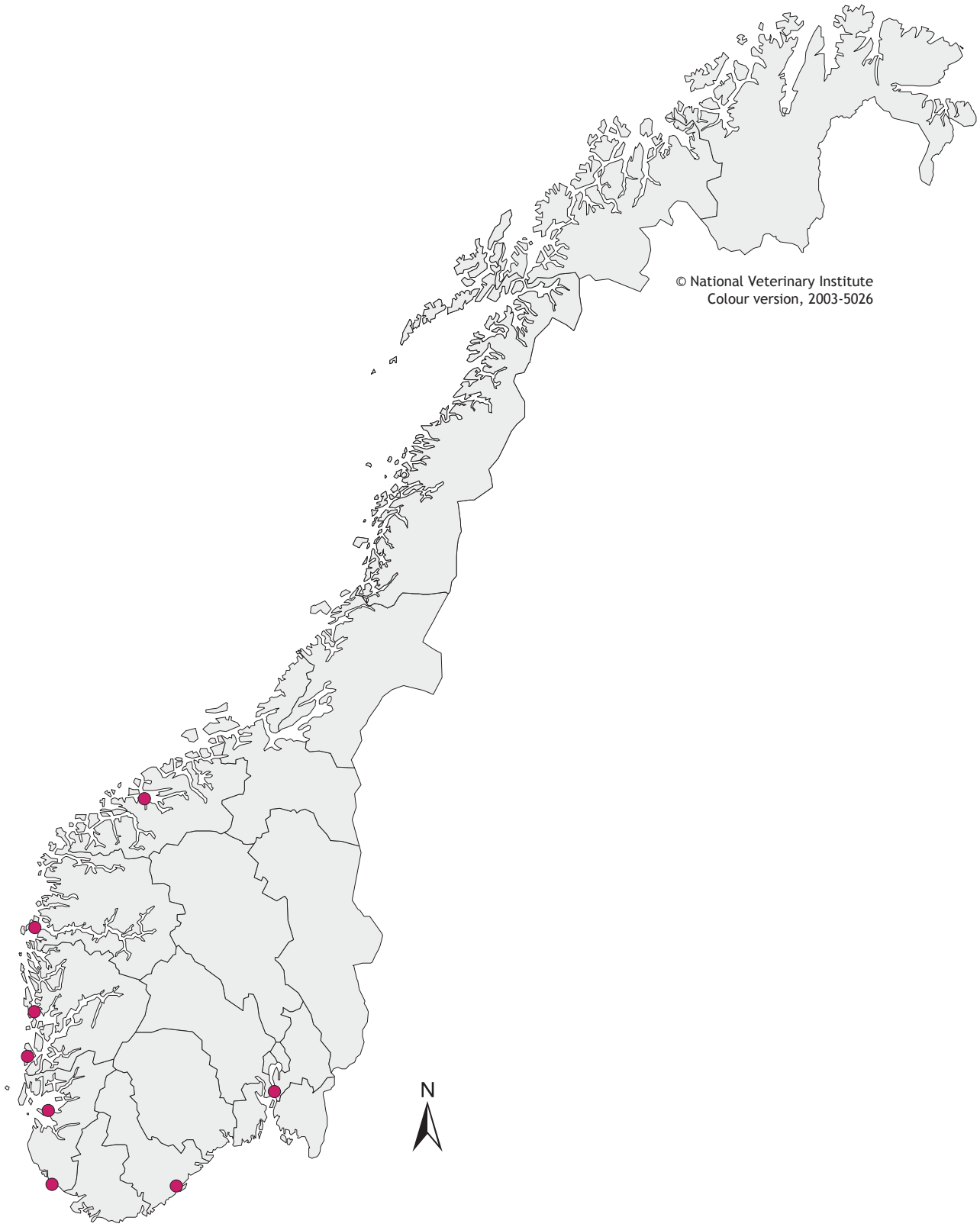


Figure 1. Geographical location of the sample sites in the surveillance and control programme for bonamiosis and marteiliosis in European flat oysters (*Ostrea edulis* L.) in 2003.

The National Veterinary Institute is a government research institution, which provides scientifically based advice to the authorities on food and feed safety and animal, fish and shellfish health. The institute performs surveillance, offers diagnostic services and maintains preparedness to deal with emergency disease situations and other important matters related to health and environment.

The institution is comprised of the central laboratory and administration located in Oslo and the regional laboratories in Sandnes, Bergen, Trondheim, Harstad and Tromsø.

The Norwegian Zoonosis Centre is organised within the National Veterinary Institute in cooperation with the National Institute of Public Health.

Homepages:
National Veterinary Institute · www.vetinst.no
Norwegian Zoonosis Centre · www.zoonose.no
Norwegian Food Safety Authority · www.mattilsynet.no