



# The surveillance programme for Chronic Wasting Disease (CWD) in free ranging and captive cervids in Norway 2020



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## Summary

A total of 22,528 samples of wild, semi-domesticated and captive Norwegian cervids were analysed in 2020. From these, one moose (*Alces alces*) tested positive for CWD. It was euthanized in Bamble municipality in Southern Norway due to a broken leg. Further, a case in wild reindeer was detected for the first time in Hardangervidda wild reindeer management area, within Vinje municipality. The reindeer was harvested during regular hunt. Both animals were males, 13 and 8 years old respectively. Both animals were detected with disease characteristics as described for the respective species in previous reports, i.e. detection of PrP<sup>Sc</sup> in lymphoid tissue from the reindeer and only in the brain for the moose. In addition, 1 reindeer from Svalbard and 35 wild muskoxen (*Ovibos moschatus*) from the Dovrefjell Mountains were tested and found negative for TSE.

## Introduction

Chronic Wasting Disease (CWD) was for the first time detected in Europe in 2016, in Norway [1]. This was also the first detection of a natural CWD infection in reindeer (*Rangifer tarandus*) worldwide. The index case in reindeer was located in Nordfjella management area in Southern Norway, and all subsequent positive reindeer until 2020 have been found in this area (Figure 1). This sub-population was eradicated in 2018 [2].

CWD is a transmissible spongiform encephalopathy (TSE) or prion disease of cervids [3]. It is an invariably fatal neurodegenerative disease with no known treatment. Well-known in North America, CWD has since the 1960's gradually spread to an increasing number of states and provinces (March 2021: 26 states in USA and three provinces in Canada), both in captive and free-ranging cervids [4]. The republic of Korea has also diagnosed the disease after importation of infected elk (*Cervus elaphus nelsoni*) from Canada [5]. With the disease emergence in Norway, naturally susceptible species also include reindeer. Norway have by now three affected species; reindeer, moose (*Alces alces*) and red deer (*Cervus elaphus*). From 2018, CWD has also been diagnosed in old moose in Finland and Sweden [6].

Four cervid species are prevalent in natural free-ranging populations in Norway: moose, red deer, roe deer (*Capreolus capreolus*), and reindeer. Red deer predominate along the west coast, whereas moose and roe deer mainly inhabit other areas of the country. The wild reindeer is found in fragmented sub-populations in the remote alpine regions of Southern Norway [7]. In addition, Norway has a population of semi-domesticated reindeer that live in a free-ranging condition, though herded. The majority of semi-domesticated reindeer are found in the northern part of Norway as part of the Sami culture, particularly in the county of Finnmark.

The official numbers (22th March 2021) of hunted cervids were in the 2020-2021 season; 31,740 moose, 50,053 red deer, 31,920 roe deer (numbers per 6<sup>th</sup> August 2020), and 4,726 free-ranging reindeer (numbers per 15<sup>th</sup> December 2020) [8]. Additionally, the semi-domestic reindeer population counts about 250,000 animals [9]. There are approximately 120 deer farms in Norway; most of them keep red deer, but some farms have fallow deer (*Dama dama*) and occasionally both species.

Testing wild cervids for CWD was initiated in 2002 through the National Health Surveillance Program for Cervids and muskox (*Ovibos moschatus*), operated by the Norwegian Veterinary Institute (NVI) on behalf of the Norwegian Environmental Agency. A passive surveillance programme for CWD in Norwegian wild and captive cervids has been running from 2003. In addition, samples from slaughtered semi-domestic reindeer from several regions in the country have been tested. In 2006 and 2007 the European Commission (decision 2007/182/EC) initiated a survey for CWD and Norway performed, like the EU member-states, testing of 700 red deer. Shown in Table 1 is the total number of cervids tested for CWD in Norway from 2002-20.

Since there is no separate program to report surveillance of TSE in muskox, such testing is included in this publication. TSE have never been reported in that species.

*Table 1: The number and species of cervids tested for chronic wasting disease (CWD) in Norway 2002-2020. Additional seven wild reindeer from Svalbard is not included in the table (one in 2020, four in 2019, two in 2018).*

Year	Moose ( <i>Alces alces</i> )	Red deer ( <i>Cervus elaphus</i> )	Reindeer ( <i>Rangifer tarandus</i> )		Roe deer ( <i>Capreolus capreolus</i> )	Fallow deer ( <i>Dama dama</i> )	Unknown Species	Total
			Semi-domestic	Wild				
2002-15	142	825	966	10	203	13	0	2 159
2016	4 403	2 582	1 739	842	484	15	87	10 152
2017	5 468	4 083	10 940	2 922	1 955	20	271	25 659
2018	6 705	8 428	12 046	3 650	2 124	48	655	33 656
2019	5 935	5 758	12 937*	3 334	1 692	37	454	30 147
2020	6 200	4 273	6 512	3 213	1 832	92	406	22 528
<b>Total</b>	<b>28 853</b>	<b>25 949</b>	<b>30 464</b>	<b>13 971</b>	<b>8 290</b>	<b>225</b>	<b>1 602</b>	<b>109 354</b>

\* Includes two reindeer not specified to wild or semi-domesticated.

## Aim

The aim of the programme is to detect the occurrence of CWD in the Norwegian cervid populations and TSE in muskoxen.

## Materials and methods

The CWD surveillance programme include slaughtered semi-domesticated reindeer (above 12 months in southern Norway and above 24 months in Northern Norway), euthanized animals and fallen stock of captive deer and semi-domestic reindeer and wild cervids (above 24 months and above 12 months respectively), and wild cervids submitted for necropsy at the NVI. In addition, since the discovery of CWD in 2016, extensive testing of hunted cervids has been implemented. This effort is a cooperation between the Norwegian Food Safety Authority, the Norwegian Environmental Agency, the Norwegian Institute for Nature Research (NINA) and NVI. Apart from cervids, wild muskoxen are also enrolled in the Norwegian surveillance of animal TSE. These animals live in the Dovre Mountains, as the only free-ranging muskox population in Norway.

The routine diagnostics of CWD require testing of brain tissue (*Medulla oblongata*). Due to early detection of prions in lymphoid tissue of reindeer in Norway, such tissue (retropharyngeal lymph nodes) have, since 2016, been added to the brain samples from cervids when available.

A rapid test (IDEXX HerdChek BSE-Scrapie AG Test, IDEXX Laboratories, Westbrook, USA) was used to screen samples from pooled brain and lymph nodes for detection of PrP<sup>Sc</sup>.

Initially positive ELISA results were retested in brain and lymph node separately, before confirmation by the TeSeE® Western-blot from Bio-Rad, according to the manufacturer's instructions. All the samples were analysed at NVI, being the national reference laboratory for animal TSEs and an OIE reference laboratory for CWD.

## Results

In total, samples from 22,528 individual cervids were analysed in 2020, of which one wild moose and one wild reindeer tested positive for PrP<sup>Sc</sup>. These two animals, both males and 13 and 8 years old respectively, shared diagnostic characteristics previously detected in their species [1,10].

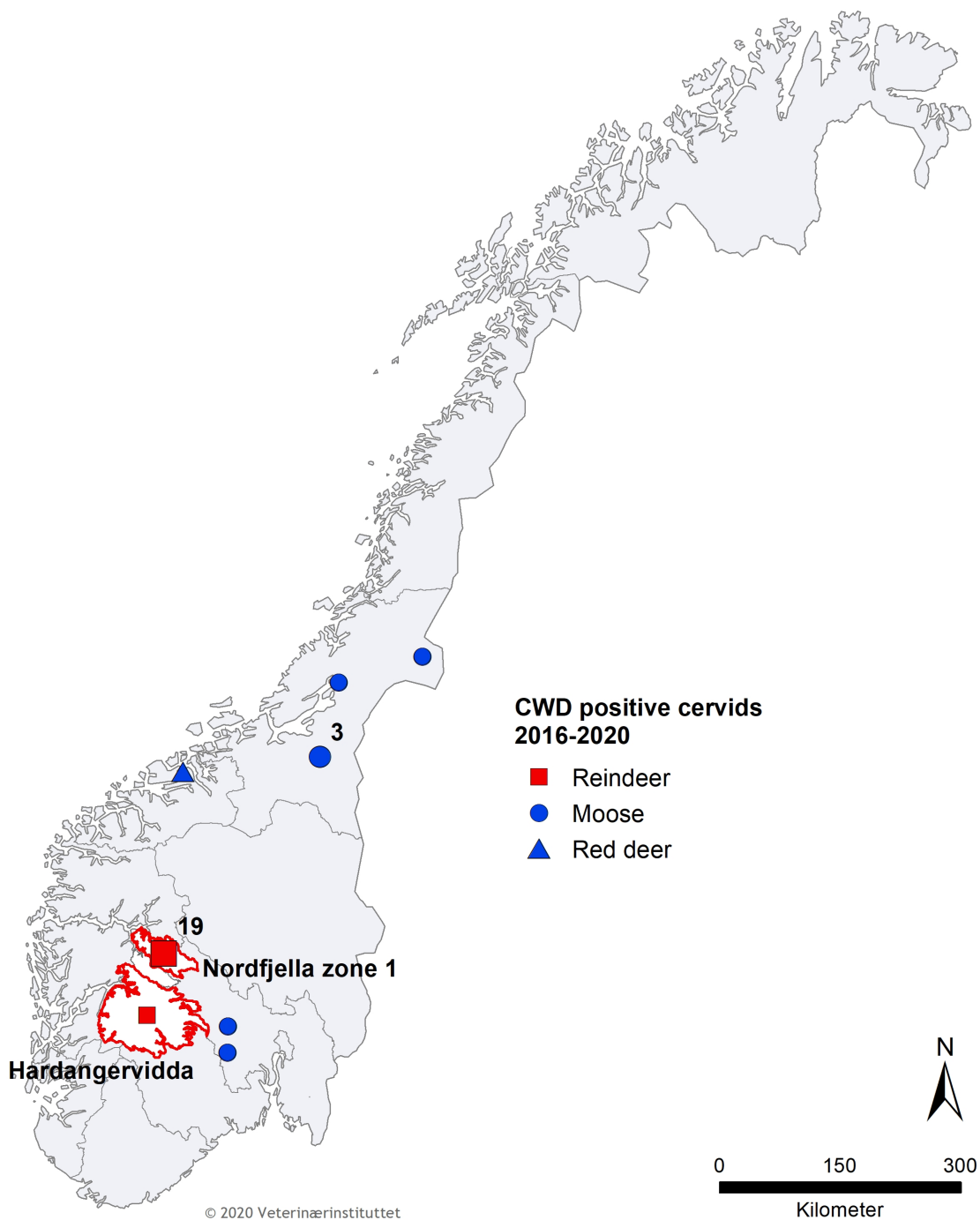
Semi-domesticated reindeer (6,512) contributed with about 29% of the total of analysed cervids. Moose samples counted 6,200 and red deer 4,273, being the two larger subgroups beside slaughtered semi-domesticated reindeer. The number of tested wild reindeer, roe deer and fallow deer was 3,213, 1,832 and 92, respectively. Amongst the total number were 406 animals of unknown species. In addition, one wild reindeer from Svalbard and 35 muskoxen were tested and found negative.

A total of 72% of the animals were tested by analysing both lymphoid tissue and brain.

Table 2 and Figures 2-9 give the numbers, species and geographical distribution of cervids tested for CWD in 2020.

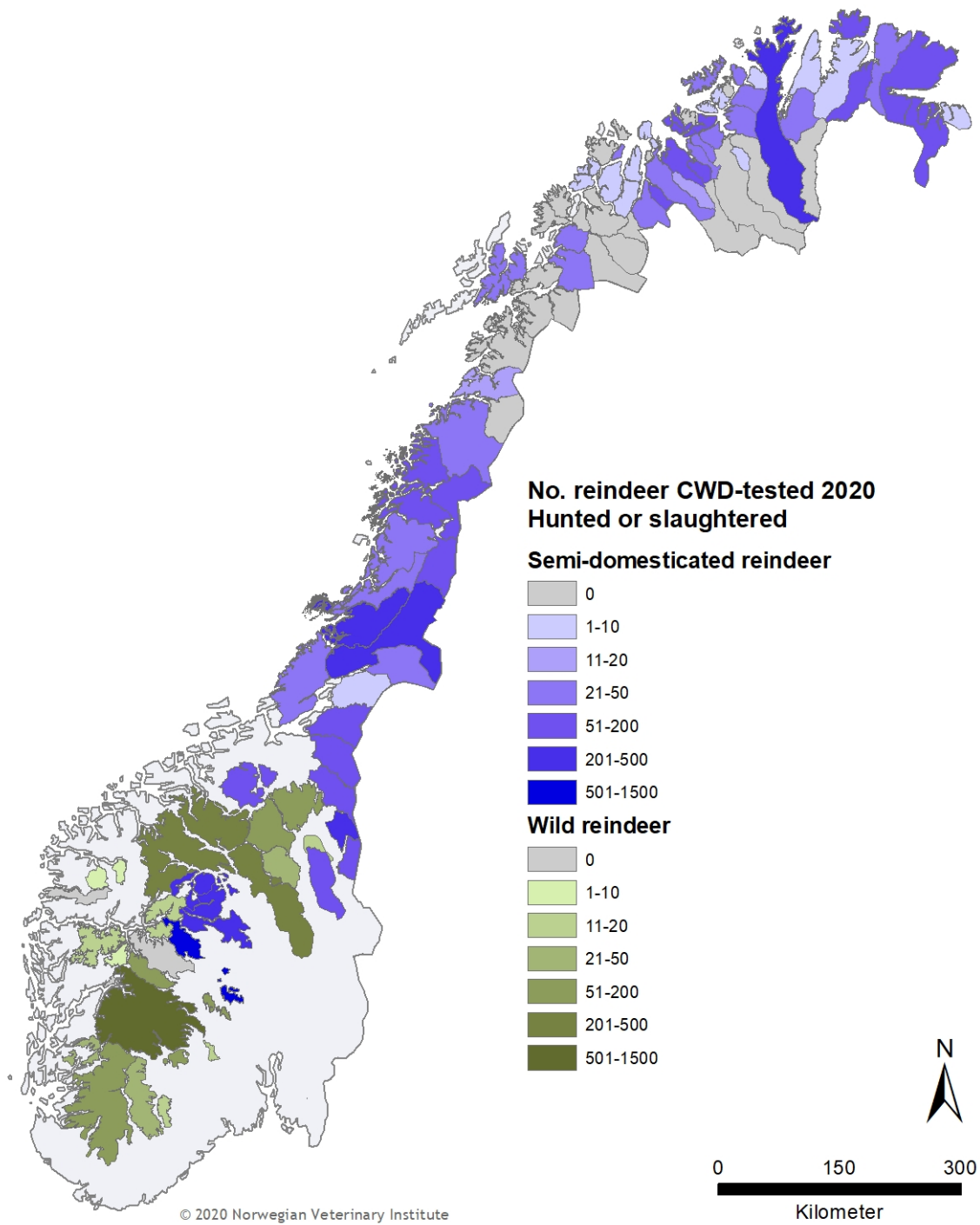
*Table 2: The number of cervids tested in the Norwegian surveillance programme for chronic wasting disease (CWD) 2020, distributed on species and reason for submission. Additional one wild reindeer from Svalbard in 2020 is not included in the table.*

Species	Wild			Captive and semi-domesticated			Total
	Hunted	Diseased, injured or traffic killed	Un-known	Slaughtered	Diseased, injured or traffic killed	Un-known	
Moose	5 458	412	329	0	1	0	6 200
Red deer	2 989	254	207	802	17	4	4 273
Reindeer	3 066	6	141	6 451	54	7	9 725
Roe deer	257	1 226	347	0	2	0	1 832
Fallow deer	5	0	0	87	0	0	92
Unknown	58	10	292	42	3	1	406
<b>Total</b>	<b>11 833</b>	<b>1 908</b>	<b>1 316</b>	<b>7 382</b>	<b>77</b>	<b>12</b>	<b>22 528</b>

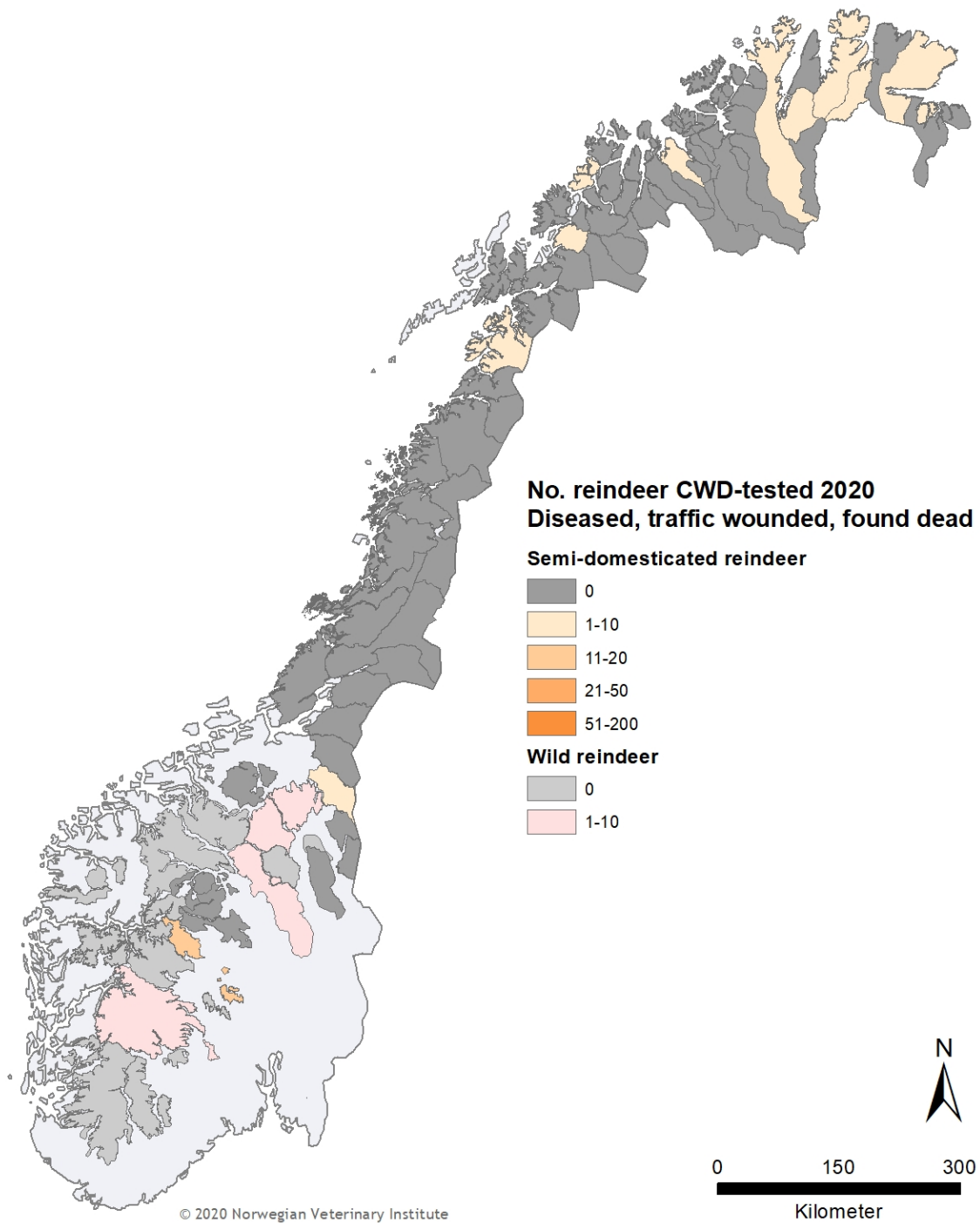


**Figure 1:** Geographical location of Nordfjella and Hardangervidda (encircled in red), and the municipalities in which the CWD positive cervids have been detected through the Norwegian surveillance programme for chronic wasting disease (CWD). Unless a single case, the number of animals at each location is given.

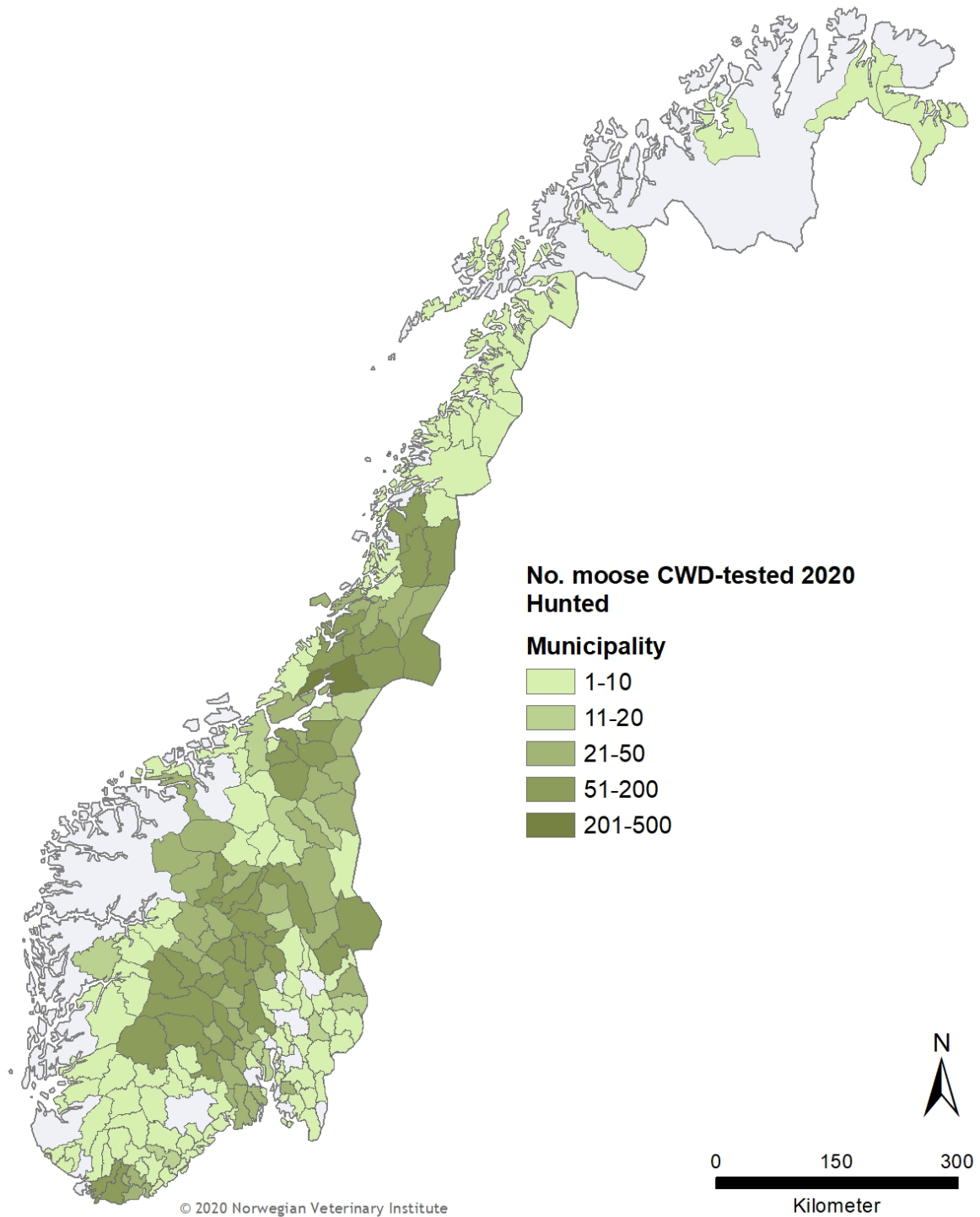




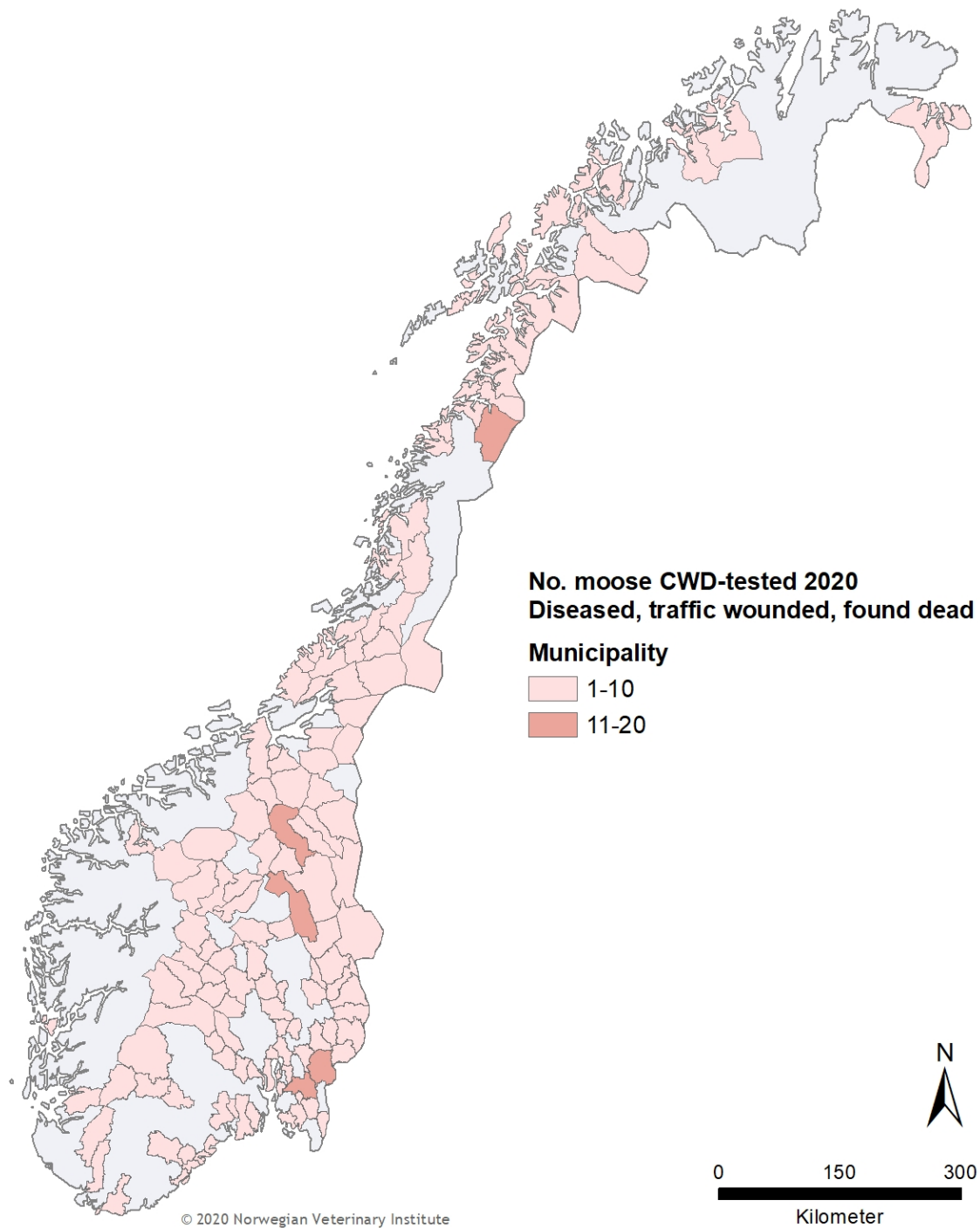
**Figure 2:** The number and geographical distribution of hunted free-ranging (green) and slaughtered semi-domestic (blue) reindeer (*Rangifer tarandus*) tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



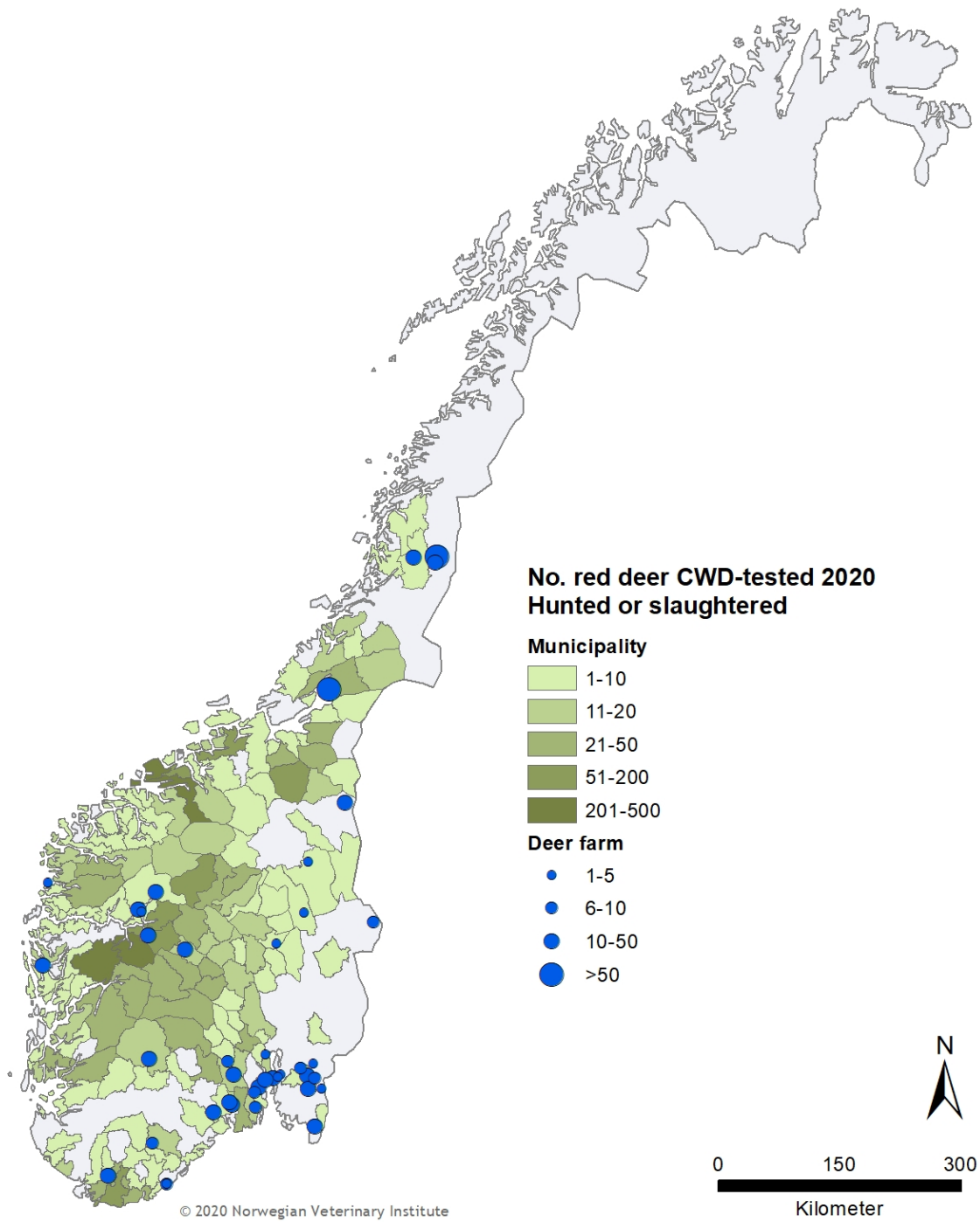
**Figure 3.** The number and geographical distribution of reindeer (*Rangifer tarandus*), both free-ranging and semi-domestic, found diseased and euthanised, traffic wounded or dead and tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



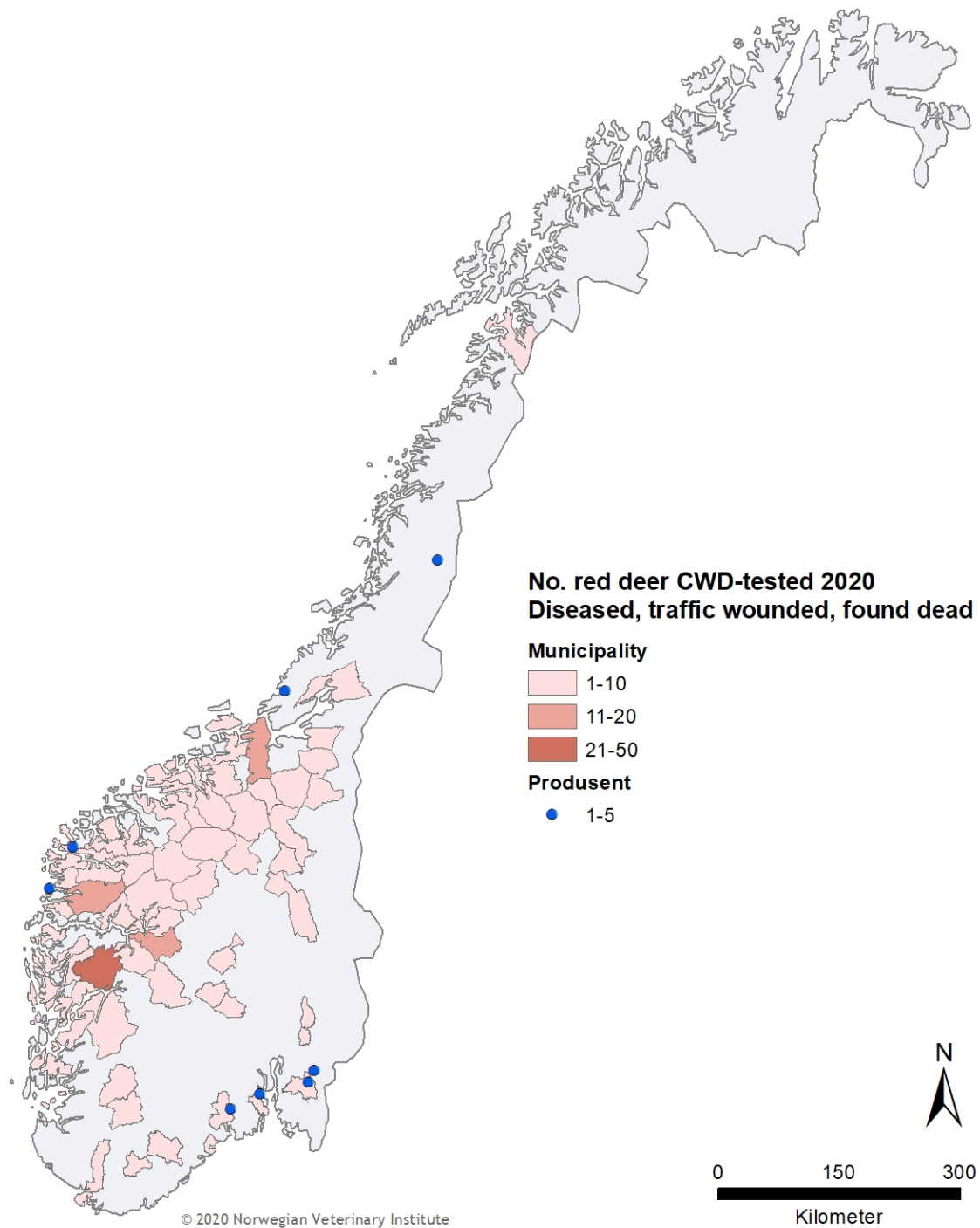
*Figure 4: The number and geographical distribution of hunted free-ranging moose (Alces alces) tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.*



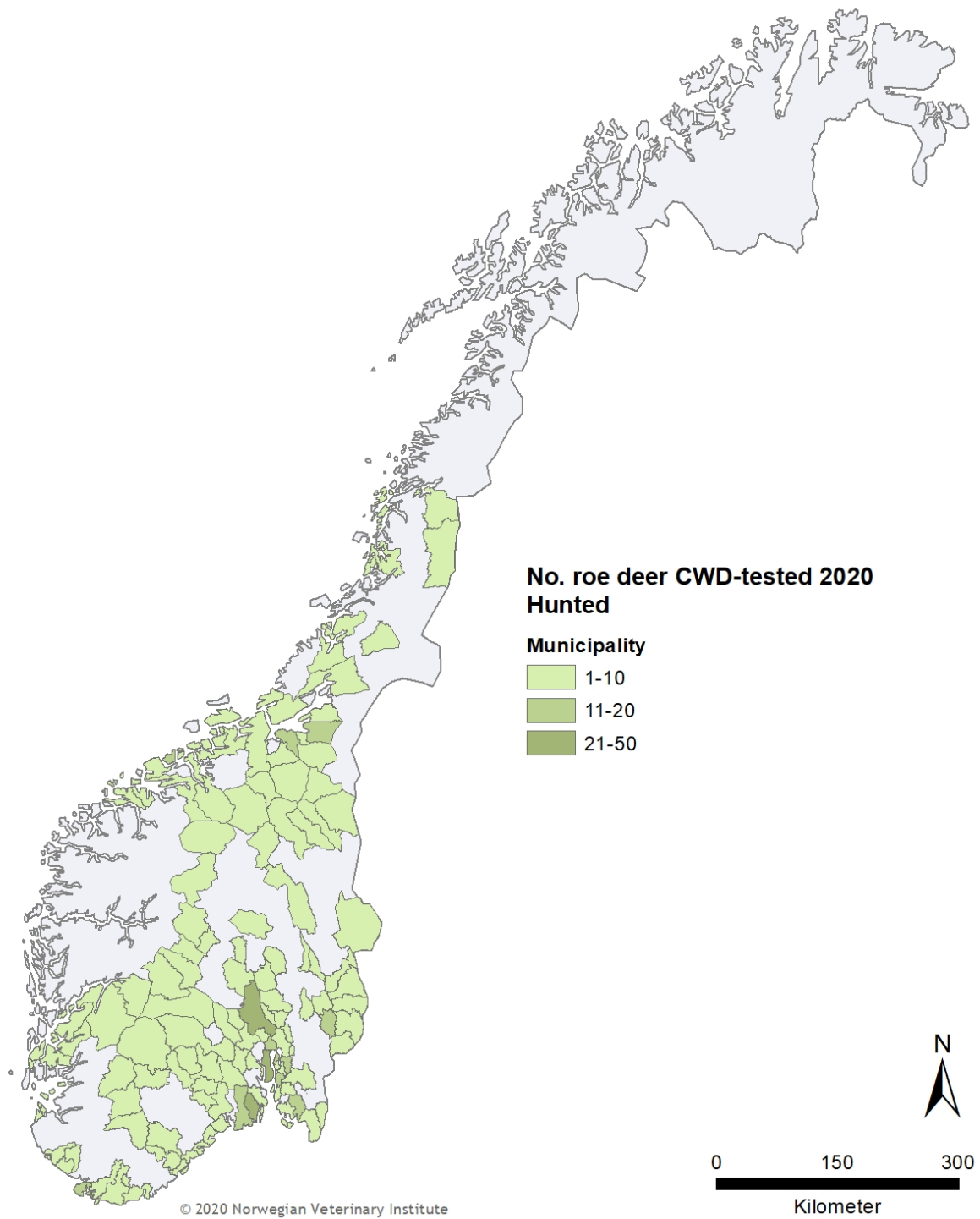
**Figure 5:** The number and geographical distribution of free-ranging moose (*Alces alces*) found diseased and euthanised, traffic wounded or dead and tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



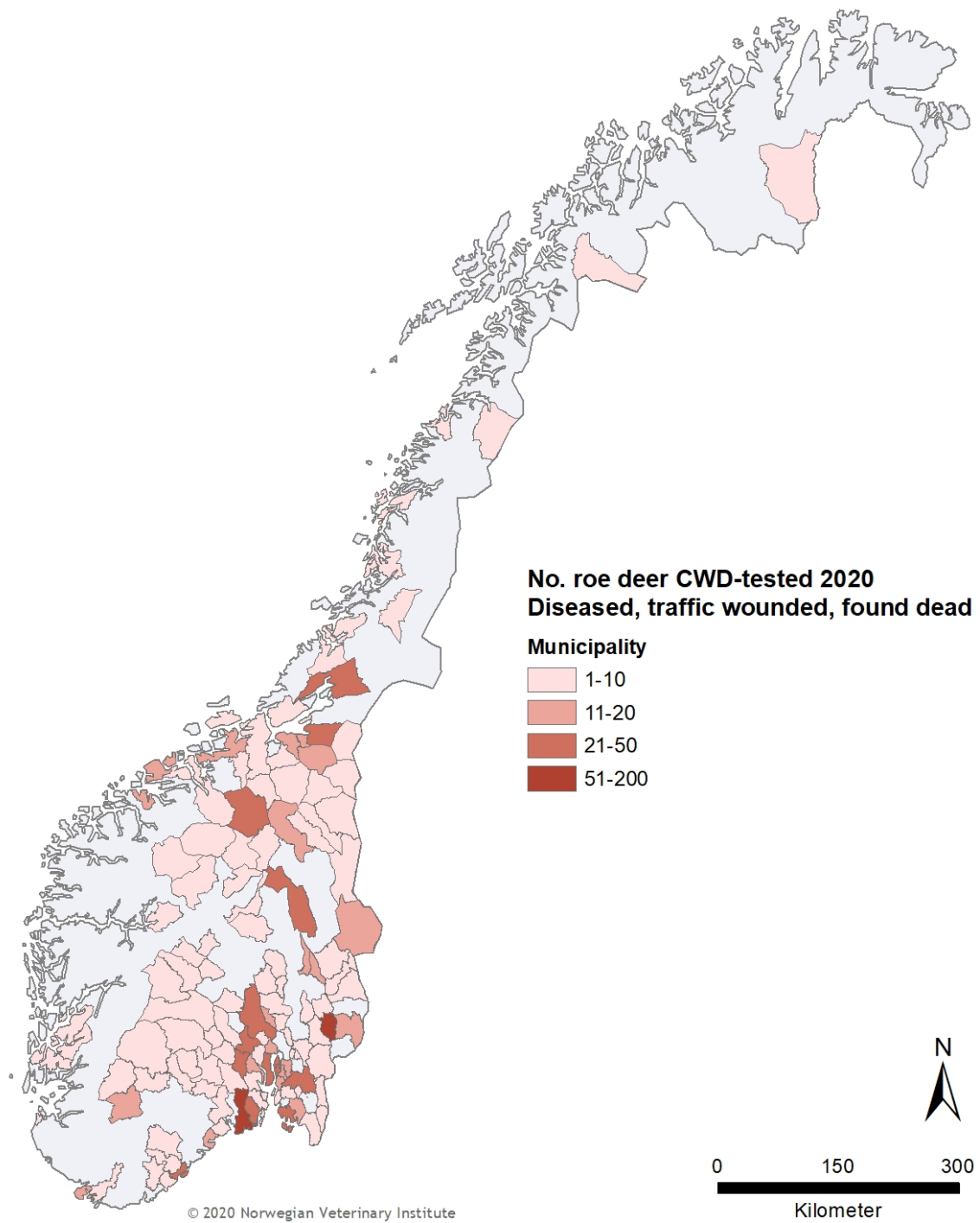
**Figure 6:** The number and geographical distribution of hunted free-ranging (green) and slaughtered captive (blue dots) red deer (*Cervus elaphus*) tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



**Figure 7:** The number and geographical distribution of free-ranging (red) and captive (blue dots) red deer (*Cervus elaphus*) found diseased and euthanised, traffic wounded or dead and tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



**Figure 8:** The number and geographical distribution of hunted free-ranging roe deer (*Capreolus capreolus*) tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



**Figure 9:** The number and geographical distribution of free-ranging roe deer (*Capreolus capreolus*) found diseased and euthanised, traffic wounded or dead and tested in the Norwegian surveillance programme for chronic wasting disease (CWD) in 2020.



## Discussion

In 2016, CWD was for the first time detected in Europe, in six free-ranging cervids in Norway. In total, the CWD testing has revealed 20 reindeer, seven moose and one red deer positive for the disease in the period 2016-2020. The first 19 reindeer cases were detected within the outbreak zone 1 of Nordfjella wild reindeer management area. The affected Nordfjella population was culled in 2018. An additional case was diagnosed in a reindeer hunted at Hardangervidda in September 2020. This discovery in a new reindeer area is challenging the effort to eradicate the disease within the reindeer populations.

Hardangervidda holds by far the largest sub-population, about 7000, of wild reindeer in Europe and the area is much less confinable in the aspect of disease spreading. Nevertheless, no reindeer-cases detected outside Nordfjella and Hardangervidda management areas, despite intensive testing, give some indications of the infection in this species being limited.

Further research studies aiming at characterizing prion strain differences have shown that the strain found in reindeer is different from those of the two other cervid species. The reindeer cases were indistinguishable, in results of diagnostic test methods, from cases of CWD from North America, whereas the positive European moose and red deer have shown atypical characteristics [6,10,11], importantly with no PrPres detection in the lymphoid tissues. Strains analysed in the Norwegian cases, across three species, were demonstrated by inoculation studies as multiple and all different from North American cases. Nevertheless, the reindeer strain has many similarities with disease from North America [12].

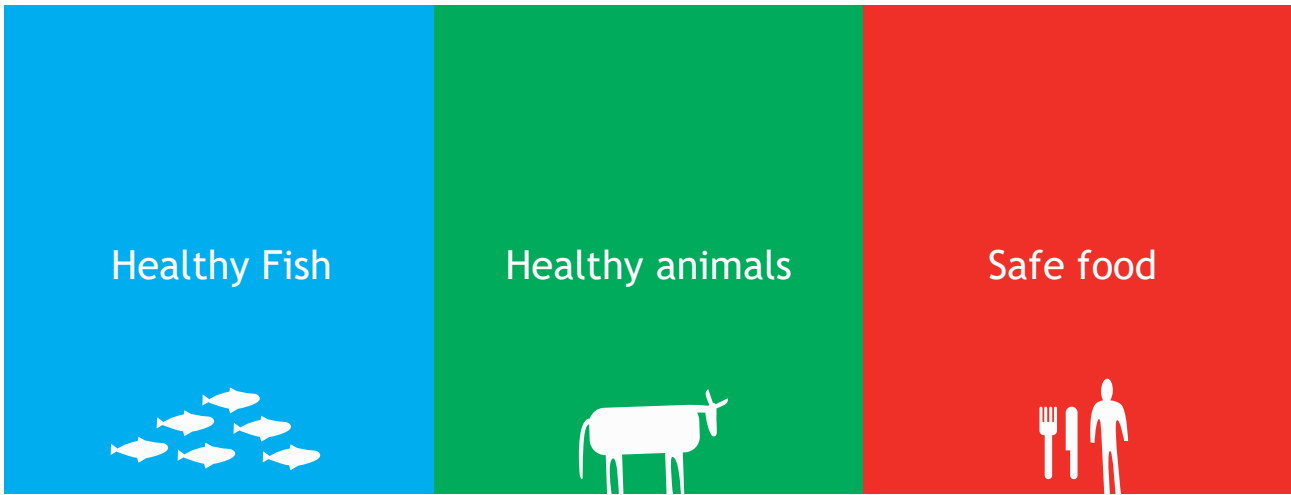
The detected numbers in moose and red deer, 7/28,853 and 1/25,949 respectively, indicate low levels of horizontal spreading, if any, between live animals in these species. TSE in domestic animals, with scrapie in sheep and BSE in cattle, have prion strains showing similar sporadic nature. Nor98 /atypical scrapie and atypical BSE have prevalence of about 6-8/10,000 and 1/3,000,000, respectively.

The number of tested cervids in Norway is not yet at a level to assure knowledge of prevalence nor to give complete understanding of CWD epidemiology. For other European countries there is even much more uncertainty as the surveillance levels are still very moderate [6].

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