Prevalence of Bovine Spastic Syndrome in Sweden

An epidemiological assessment

Teodora Linton Fischer

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Swedish University of Agricultural Sciences, SLU
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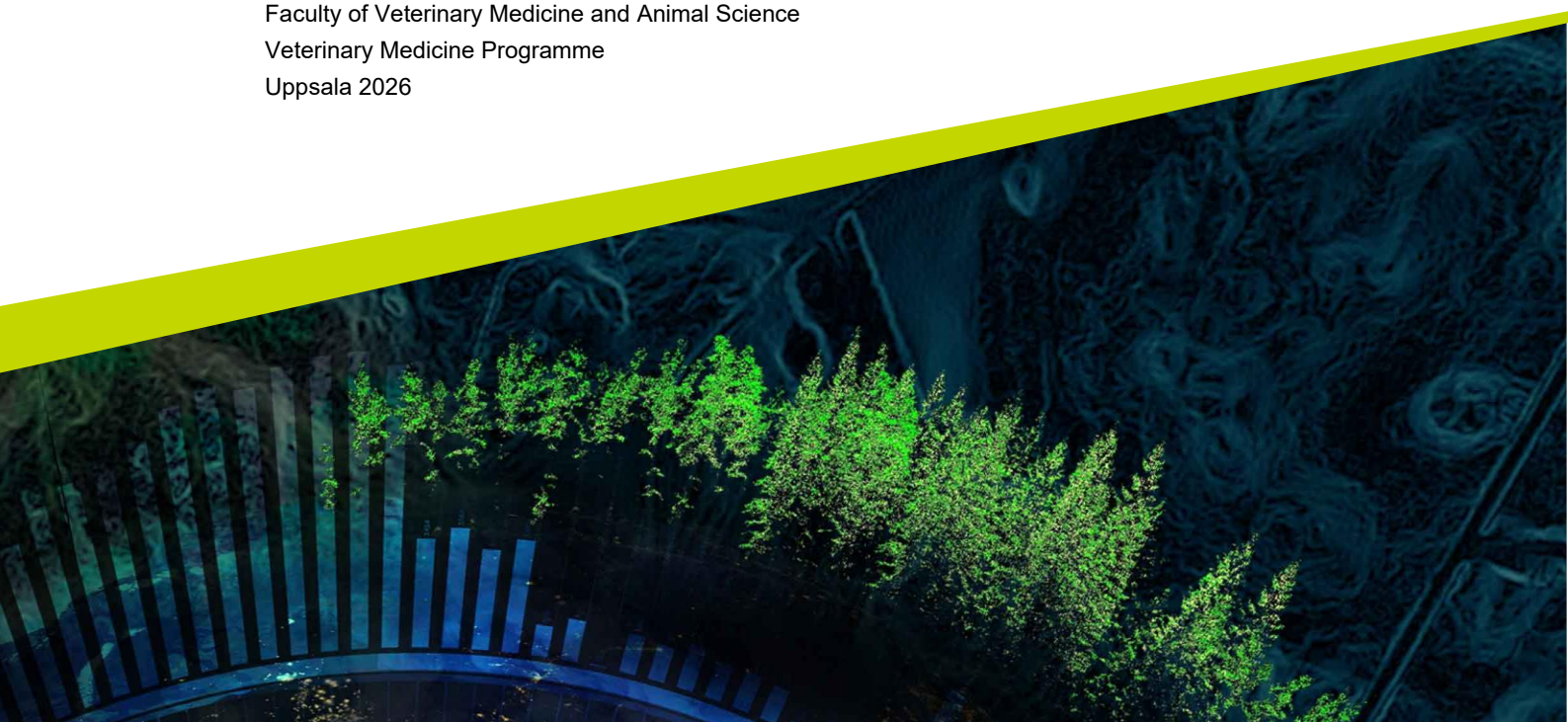

Prevalence of Bovine Spastic Syndrome in Sweden – an epidemiological assessment

Prevalens av bovint spastiskt syndrom i Sverige – en epidemiologisk bedömning

Teodora Linton Fischer

Supervisor:	**Jean F Valarcher, Swedish University of Agricultural Sciences, Department of Clinical Sciences**
Assistant supervisor:	Sara Hägglund, Swedish University of Agricultural Sciences, Department of Clinical Sciences
Assistant supervisor:	Karin Alvåsen, Swedish University of Agricultural Sciences, Department of Clinical Sciences
Examiner:	Katrina Ask, Swedish University of Agricultural Sciences, Department of Animal Biosciences

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Faculty of Veterinary Medicine and Animal Science
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Abstract

Bovine Spastic Syndrome (BOSS) is a chronic, progressive neuromuscular disorder that affects adult cattle. The disorder causes intermittent episodes of painful cramps in the hindlimbs that impair movement. Little is known about its presence in Sweden. This study aimed to explore the occurrence of clinical signs compatible with BOSS in Swedish cattle herds and to identify herd-level factors associated with farmer-reported cases. An online survey aimed at Swedish cattle owners was conducted between June and September 2025, yielding 201 responses from all 21 counties and a range of production systems.

Approximately one-third of respondents reported having observed animals over three years of age showing clinical signs consistent with BOSS. Reports were geographically widespread but varied by county. Observations were substantially more common in dairy herds: 60% of dairy respondents had observed signs, and dairy producers accounted for 80% of all positive reports. In contrast, only 6% of beef producers reported observing signs.

Although the study relied on self-reported observations and cannot confirm clinical diagnoses, the results indicate that clinical signs compatible with BOSS are present in many parts of Sweden and may be more frequently recognized in dairy systems. These findings highlight the need for improved diagnostic awareness, targeted epidemiological surveillance, and further investigation into risk factors and potential genetic components of the syndrome.

Keywords: cattle, crampiness, Krämpfigkeit, spastic syndrome, stretches, hereditary diseases, neuromuscular disorder, survey

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Abbreviations

Abbreviation	Description
AI	Artificial insemination
BOSS	Bovine spastic syndrome
BSP	Bovine spastic paresis
N	Number of observations
SCB	Statistiska centralbyrån (Statistics Sweden)
SKB	Svensk kullig boskap (Swedish Polled)
SLB	Svensk låglandsboskap (Swedish Holstein)
SLU	Sveriges lantbruksuniversitet (Swedish University of Agricultural Sciences)
SRB	Svensk rödbrokig boskap (Swedish Red-and-White)

1. Introduction

Bovine Spastic Syndrome (BOSS) is a chronic, progressive neuromuscular disorder affecting cattle in many countries, including Sweden. The syndrome most commonly appears in older animals and is characterized by muscle spasms, primarily in the hind limbs, though in advanced cases the back and neck may also be affected (Frauchiger & Hofmann 1941). The condition compromises animal welfare and poses economic challenges for farmers. It can lead to production losses, premature culling, and increased veterinary costs (Gentile & Testoni 2006). No cure is currently available, and treatment options are limited to symptomatic relief (Goeckmann et al. 2018). Because modern dairy and beef production increasingly maintains cattle for longer productive lifespans (Brito et al. 2021), age-related neuromuscular syndromes such as BOSS are likely to become more prevalent.

The literature on BOSS is limited, and many key aspects of the disorder remain poorly understood, including its etiopathology and mode of inheritance. A review by Goeckmann et al. (2018) highlights this overall scarcity of research and, among other gaps, points to the lack of studies addressing the prevalence of BOSS. Reported prevalence estimates range from approximately 0.2% to 0.5% in classified Holsteins (Van Doormaal 2013, Lactanet 2021), with some sire lines showing higher frequencies. In Sweden, individual cases have been reported, indicating that the disorder may be widespread (Hägglund et al. 2023). However, no systematic data exist on its prevalence within the country. This hampers further research on etiology, genetic predisposition, and strategies for disease control. Given the suspected genetic basis of BOSS (Condello et al. 2025, Krull et al. 2020), such information could also guide breeding decisions to reduce disease transmission. The neurodegenerative nature of BOSS also shows parallels to human disorders such as multiple sclerosis, which underlines the broader scientific relevance of understanding its pathogenesis (Krull et al. 2020). Overall, BOSS is considered a rare, sporadic, and likely underdiagnosed neuromuscular syndrome with variable herd-level impact.

To further explore the prevalence of BOSS in Sweden, an online survey was distributed to cattle owners across Sweden to collect information on observed clinical signs, herd characteristics, and perceived trends over time. The purpose of this study was to investigate the occurrence of BOSS-like clinical signs in Swedish cattle herds, with a focus on differences between breeds and production systems. In addition, it was hypothesized that herds reporting BOSS-like clinical signs might exhibit higher replacement rates than herds without such reports. Alternatively, lower replacement rates could be associated with an older herd age structure, potentially increasing the likelihood of observing age-related disorders such

as BOSS. A further aim was to identify herds that could serve as potential candidates for future research on BOSS.

2. Literature Review

2.1 Introduction

In 1941, Frauchiger and Hofmann described a newly discovered neurological disorder in cattle that they termed *Krämpfigkeit des Rindes* ("crampiness of cattle"). This central nervous system disorder was characterized by spasms in the hind limbs of older animals. Since then, the condition has been reported worldwide under various names, including *Stallkrampf*, crampy, barn cramps, stretches, progressive posterior paralysis and bovine spastic syndrome (BOSS) (Goeckmann et al. 2018). Despite this long history the scientific literature on BOSS remains limited. BOSS is classified as a syndrome because it is diagnosed based on a consistent constellation of clinical signs, whereas its underlying cause has not been conclusively identified and may involve multiple interacting factors.

Bovine spastic syndrome is assumed to be an inherited, chronic-progressive, neuromuscular degenerative disorder. In addition to hereditary explanations, several non-genetic factors have been suggested (Goeckmann et al. 2018). These include nutritional deficiencies, seasonal patterns, environmental factors and muscular or metabolic abnormalities. It appears to primarily affect older cattle, usually over three years, of all breeds and sexes (Becker et al. 1961, Goeckmann et al. 2018). The disorder impacts animal welfare and herd economics (Gentile & Testoni 2006). Although BOSS has been recognized for over 80 years, key aspects such as its genetic background, diagnosis, and epidemiology remain poorly understood (Goeckmann et al. 2018, Krull et al. 2020, Jacinto et al. 2024).

2.2 Clinical Signs

The primary clinical sign of BOSS is intermittent episodes of spastic muscular contractions, primarily affecting one or both hindlimbs (Roberts 1965, Goeckmann et al. 2018). In the early stages clinical signs are often subtle which can make detection difficult. Affected animals may experience only mild, rare cramps in the hindlimbs for several years before the disorder progresses.

As the disorder progresses, the spastic contractions gradually spread to the muscles of the pelvic girdle, rump, and eventually the neck and forelimbs (Dirksen et al. 2006, Gentile & Testoni 2006, Goeckmann et al. 2018). The condition is chronic, progressively worsening, and irreversible. During attacks animals may show flexion and lifting of one hindlimb, often accompanied by muscular tremors and kyphosis. During more severe attacks affected cattle can adopt a characteristic "sawhorse" posture with marked kyphosis, the hindlimbs

extended rigidly behind the body, the forelimbs extended forward, and little weight supported by the hindquarters. Clinical signs show only when the animal is standing or moving and are not apparent when the animal is sleeping or lying down. Individual cramps can last from a few seconds to several minutes while the overall episode may persist for up to an hour or longer.

The disorder is characterized by an alternation of symptomatic and asymptomatic periods (Dirksen et al. 2006, Gentile & Testoni 2006, Goeckmann et al. 2018). Episodes of severe spastic attacks may occur over one to three days followed by intervals of mild or no clinical signs lasting for weeks or months. As the disorder progresses attacks become longer, more frequent and more severe until the animal experiences persistent disability.

Krull et al. (2020) additionally report behaviors that imply discomfort or pain in affected animals, including vocalization, restless behavior while standing and repeated consumption of small amounts of feed during spasms. Affected bulls show an increased tendency to lie down. These signs of pain and functional impairment indicate a substantial welfare burden for affected animals.

Affected animals may develop secondary diseases such as foot rot and arthritis (Roberts 1965). Additionally, severe clinical signs may cause difficulty in eating and lead to weight loss and decreased production. Bulls may become unable to mount (Roberts 1953).

2.3 Epidemiology

The first description of BOSS was made by Frauchiger and Hofmann in 1941 in Germany and Switzerland, and Roberts (1953) later reported cases in the United States. Since then, the syndrome has been described in numerous breeds, including Holstein, Guernsey, Ayrshire, Jersey, and Hereford cattle (Becker et al. 1961), and is now assumed to occur in all dairy and beef breeds (Goeckmann et al. 2018).

BOSS predominantly affects cattle over three years of age, with most reports describing onset between three and seven years of age (Becker et al. 1961, Goeckmann et al. 2018). Cases occur in both sexes, although the syndrome is particularly well documented in breeding bulls, in part due to intensive monitoring at artificial insemination (AI) centers (Krull et al. 2020). High-yield dairy herds appear to be at increased risk, possibly due to longer productive lifespans and greater physiological demands (Becker et al. 1961, Dirksen et al. 2006).

Available reports suggest that the overall prevalence is low but may vary widely between herds. Data from the Canadian Dairy Network indicated a prevalence of approximately 0.2% among Holstein cattle between 1994 and 2004, increasing to around 0.5% in 2013 (Van Doormaal 2013, Lactanet 2021). In contrast, substantially higher prevalence has been reported in AI centers housing elite breeding bulls, with estimates reaching up to 30% in some cohorts (Tenszen 1998, Goeckmann et al. 2018). More recent data from a large Canadian field study reported an overall prevalence of 3.6% among adult Holstein cattle, with marked variation between herds (mean within-herd prevalence 4.7%, range 0.1–31.8%) (Condello et al. 2025). The authors noted that these estimates were likely conservative due to voluntary reporting but nevertheless support the conclusion that while BOSS remains relatively uncommon at the population level, it may be locally frequent within affected herds.

The economic impact of BOSS can be substantial. Affected animals experience pain, reduced mobility, and progressive loss of function, leading to diminished productivity and, in the case of breeding bulls, loss of genetic potential (Krull et al. 2020). Premature culling or euthanasia due to welfare concerns contributes further to financial losses for dairy and AI operations.

2.4 Diagnosis

BOSS is challenging to diagnose due to large variation in age of onset, intermittence of clinical signs, and the long symptom-free intervals characteristic of the syndrome (Goeckmann et al. 2018). At present, there is no diagnostic test available. Sources of secondary muscle cramps, musculoskeletal disorders, or other causes that could result in stretching of the affected leg backward, must first be ruled out, including claw disease, osteochondrosis dissecans, and arthritis.

Because the clinical presentation overlaps with bovine spastic paresis (BSP), distinguishing between the two disorders is essential (Goeckmann et al. 2016, Goeckmann et al. 2018). BSP is also a true cramp disorder, but it differs from BOSS in several key aspects. While both conditions are neuromuscular disorders characterized by spastic contractions of the hindlimbs, they differ in age of onset, progression, and clinical presentation. BSP typically appears in young calves between three and nine months of age and is characterized by a permanent hyperextension of one hindlimb, producing a rigid “pegged leg” gait with an elevated tail carriage. In contrast, BOSS affects mature cattle, usually between two and seven years old, and presents as intermittent episodes of hindlimb hyperextension accompanied by head raising and a characteristic stretching posture. Early signs may include tremors or pressing against the neck rail when rising, and clinical signs tend to progress over time. While BSP generally affects one hindlimb,

BOSS more often involves both hindlimbs and may extend to the back and neck in advanced cases. Surgical treatment can be effective for BSP, whereas BOSS can only be managed symptomatically. A late-onset form of BSP has been reported, with onset between two and six years of age, resulting in partial overlap with the typical age range of BOSS. Both conditions share similar features in that clinical signs are seen only when the animal is standing or moving, and recovery does not occur.

Krull et al. (2020) further emphasize that the intermittent nature of BOSS, the spacing of crises, and the progressive extension of spasms are key elements of clinical differentiation, along with the nervous behavior and pain-related signs observed during episodes.

2.5 Treatment and Control

There is no drug treatment or permanent cure for BOSS. Animal welfare can be improved for suffering animals and symptomatic treatment aims to reduce the severity and frequency of spasms. Several supportive measures have been reported in the literature. Moderate daily exercise, the provision of warm and non-slippery flooring, comfortable stalls, and attention to claw care can alleviate clinical signs and help affected animals maintain mobility (Roberts 1965, Goeckmann et al. 2018).

For severe attacks it is recommended to use analgesics, as affected animals show clear evidence of pain (Goeckmann et al. 2018). Drugs with anti-inflammatory effects can help manage pain and inflammation from secondary conditions such as arthritis. Tranquilizers have also been described as beneficial, likely because fear and agitation can exacerbate the severity of the spasms.

However, the practical use of sedative or analgesic drugs in dairy and beef cattle is constrained not only by withdrawal periods but also by the fact that a veterinarian is not always present when episodes occur (Goeckmann et al. 2018). While certain sedatives, such as xylazine, do not carry a withdrawal period for milk, their administration still requires veterinary involvement. Sedation may nevertheless be necessary in specific management situations, for example during claw trimming, which can be particularly challenging for animals showing clinical signs compatible with BOSS. Clinical observations indicate that some affected cows experience pronounced difficulty tolerating the trimming chute, likely due to discomfort, reduced stability, or heightened sensitivity during handling. In addition to medical management, alternative medicine such as chiropractic and manual therapies have been reported anecdotally to provide temporary relief, although no controlled studies have evaluated their efficacy.

There is no indication that the animal can recover from BOSS (Goeckmann et al. 2018). There are no described surgical treatments, and the disorder is considered irreversible. Because progression is slow, some animals may remain functional for years, but repeated episodes can eventually lead to self-injury, reduced productivity, or compromised welfare. In such cases, euthanasia may be warranted either for humane reasons or because the animal can no longer maintain adequate production and cannot be safely transported for slaughter.

2.6 Etiopathology

The etiology of BOSS remains unclear. Since its first description, the disorder has been suspected to have a hereditary basis (Frauchiger & Hofmann 1941), but no definitive proof of pathogenesis or etiology has yet been established (Goeckmann et al. 2018). Inflammatory or infectious causes are considered unlikely, as blood analyses of affected animals have not revealed consistent signs of infection or systemic inflammation (Tenszen 1998). Similarly, no characteristic pathological lesions have been identified in skeletal muscle, peripheral nerves, or the central nervous system (Frauchiger & Hoffmann 1941, Wells et al. 1987), and serum calcium and phosphorus levels are within normal ranges (Frauchiger & Hoffmann 1941).

A genetic contribution is currently the most strongly supported predisposing factor, although the underlying architecture appears complex rather than monogenic (Goeckmann et al. 2018). Studies have demonstrated familial clustering and breed predispositions (Becker et al. 1961, Goeckmann et al. 2018). Genome wide association studies (GWAS) have identified regions of interest on chromosomes 7, 8, 9, 15, and 19 (Neustaeter 2015, Krull et al. 2020, Neustaeter et al. 2023). In one study, Krull et al. (2020) detected a frameshift variant in a novel adenosine-A1 receptor homolog (LOC100848076) on chromosome 15, potentially affecting neuronal signal transmission. However, this variant was found at a relatively high frequency in the cattle population, suggesting that additional genetic or environmental factors may contribute.

Population-based genetic analyses further support a complex genetic architecture underlying BOSS. A large study of Canadian Holstein cattle, including over 54,000 animals, estimated the heritability of BOSS to be low to moderate on the observed scale (approximately 0.06–0.09), consistent with a multifactorial trait rather than a single-gene disorder (Condello et al. 2025). GWAS identified multiple associated loci, with each variant explaining only a small proportion of the genetic variance. These findings reinforce the view that BOSS is polygenic and genetically heterogenous.

Recent whole-genome sequencing (WGS) work has strengthened the view that BOSS is genetically heterogeneous. Jacinto et al. (2024) identified eight different deleterious variants across seven affected Holstein cattle, including both recessive and dominant mutations in genes associated with neuromuscular function in other species. These findings suggest that BOSS may resemble human neuromuscular disorders in which multiple, distinct genetic pathways can produce clinically similar phenotypes.

Parallels with human hereditary spastic paraplegias (HSPs) have long been noted (Evers 1948, Goeckmann et al. 2018). HSPs are characterized by slowly progressive spasticity of the hind limbs, late onset, and marked genetic heterogeneity, involving more than 80 known genes with autosomal dominant, recessive and X-linked inheritance. The similarities in clinical presentation, particularly progressive hindlimb spasticity, and the diversity of genetic findings in cattle support the hypothesis that BOSS represents a complex neurodegenerative syndrome, potentially involving multiple molecular pathways.

No association with sex has been demonstrated, and a single dominant gene appears unlikely (Becker et al. 1961). Several non-genetic predisposing factors have also been proposed. Higher reported incidence in high-yield dairy cattle and breeding bulls suggests that production level, longevity, and physiological stress may influence susceptibility (Becker et al. 1961, Dirksen et al. 2006). Goeckmann et al. (2018) additionally noted potential environmental and nutritional influences, although these remain speculative. Overall, current evidence supports a model in which BOSS arises from an interaction of genetic susceptibility and modifying factors, resulting in a variable and heterogeneous clinical presentation.

3. Material and Methods

3.1 Population: Farmers and Hobby Farmers

The target population consisted of cattle owners in Sweden. The survey was disseminated using multiple channels to maximize reach. These included an article on the topic published in ATL (Lantbrukets Affärstidning), a newspaper in print and digital form aimed at Swedish farmers. Additional outreach consisted of digital advertisements in ATL (www.atl.nu), Nötkött (www.notkott.se), a platform focused on beef cattle production, and Husdjur (www.husdjur.se), which covers livestock farming more broadly. The campaign also included posts in 17 Facebook groups directed at Swedish farmers and cattle owners (see Appendix 3), as well as an email distributed to members of SRB-gruppen, an association for owners of Swedish Red-and-White cattle. To avoid bias and ensure a representtative sample, the advertisements were written in a neutral tone and did not explicitly mention BOSS as the subject of the study (see Appendix 2).

3.2 Survey

A survey was designed and distributed to investigate the prevalence of bovine spastic syndrome (BOSS) in Swedish cattle herds. The survey was constructed using Netigate (Netigate AB, Stockholm, Sweden), an online survey platform. It contained a total of 14 questions. The full survey is included in Appendix 1.

The survey consisted of both multiple-choice and open-text questions. Questions addressed herd characteristics, whether clinical signs consistent with BOSS had been observed or not, and the frequency of such observations. To facilitate recognition, a description of typical clinical signs was provided, accompanied by photographs.

The survey was intentionally kept short to encourage participation and completion, and most questions were presented in multiple-choice format. Before distributing the survey, it was reviewed by veterinarians and researchers with expertise in cattle health and BOSS, including researchers at SLU with expertise in bovine health and BOSS. The reviewers provided feedback on question clarity, relevance, and structure, and revisions were made accordingly prior to launching the final version.

3.2.1 Respondent and Herd Information

The full wording of all questions referred to in this section is provided in Appendix 1.

Question 1 asked respondents whether they had observed animals over three years of age in their herd showing clinical signs compatible with BOSS.

Question 2 asked respondents to indicate in which Swedish county their herd was located.

Question 3 included a free-text field for reporting herd size in 2025; these entries were converted to numeric values for analysis.

Question 4 asked what kind of production the herd represented, offering multiple-choice options for dairy, beef, both dairy and beef, or other. Respondents selecting "other" could specify details in a free-text box. Because respondents could choose multiple options, those who selected both dairy and beef were grouped into the category "both dairy and beef."

Question 5 concerned breed composition. Respondents could choose from a list of common Swedish breeds (see Appendix 1) and additional options for other pure breed, crossbred between SLB and SRB, or other mixed breed. Respondents who indicated "other pure breeds" could not specify which breeds these were, whereas respondents selecting "other mixed breeds" could describe the combination in a free-text box.

3.2.2 Observation of Clinical Signs

The full wording of all questions referred to in this section is provided in Appendix 1.

Question 6 asked respondents to report the annual replacement rate in their herd as a free-text percentage. Responses indicating rates of 0%, 1%, or 100% were excluded as implausible.

Question 7 asked whether respondents had experienced an increase in clinical signs compatible with BOSS during the past 5–10 years (multiple choice).

Question 8 asked how many animals in the herd had shown such clinical signs within the last five years.

Question 10 asked for the sex of affected animals, allowing multiple selections.

Question 11 asked for the age at which clinical signs typically first appeared, offering single-choice options.

Question 12 asked respondents with multiple breeds to specify in which breed or breeds the signs had been observed, using a free-text field.

3.2.3 Other Questions

The full wording of all questions referred to in this section is provided in Appendix 1.

Question 9 asked whether respondents had experienced any consequences of BOSS, using a multiple-choice list where several options could be selected, as well as an "other" option with a free-text box for additional comments.

The final two questions collected respondents' contact information and their willingness to participate in future studies on the topic.

3.3 Data Collection

The survey was open from 19 June to 3 September, 2025. A total of 201 respondents participated, of whom 157 completed the survey, corresponding to a completion rate of 78%. All responses were collected anonymously.

Data on the number of cattle per county were obtained from Statistics Sweden (Statistiska centralbyrån, SCB). The publicly available dataset *Nötkreatur efter län och djurkategori* was used to retrieve the total number of cattle in each Swedish county for 2025. SCB notes that cattle statistics for this period are based on the Central Cattle Database (CDB) and represent the number of animals registered on the designated reference date in early June.

3.4 Data Management, Analyses and Statistics

Data was screened for completeness and plausibility before analysis. Responses containing inconsistencies or implausible values were excluded to ensure data reliability. For example, reported herd replacement rates of 0%, 1%, or 100% were considered erroneous entries and were removed prior to analysis.

Data was managed and analyzed in Microsoft Excel (Microsoft Corporation, USA). Reported replacement rates (entered as free-text responses) were converted to numeric values and analyzed as continuous variables. Replacement rates were analyzed separately for SLB and SRB herds to evaluate possible breed-specific

differences. Mean replacement rates between herds that had and had not reported BOSS symptoms were compared using two-sample *t*-tests assuming unequal variances (Welch's t-test), performed in Microsoft Excel.

3.5 Ethics

Responses were collected anonymously, and participation was voluntary. No personal data were collected, and completion of the survey was considered to constitute informed consent.

4. Results

4.1 Respondents

A total of 201 respondents participated by answering at least one question, of whom 157 completed the survey, corresponding to a completion rate of 78%.

Respondents represented a range of production systems and could select more than one option. Half (50%) identified primarily as dairy producers, while 38% identified as beef producers. In the “Other” category, where free-text responses were allowed, the most common answer (n = 7) was grazing or nature conservation (*öppna landskap*).

4.2 Geographic Distribution of Survey Responses

Responses were received from all 21 counties in Sweden, providing nationwide coverage, although the number of responses per county varied from 1 to 36. The highest number of respondents came from southern Sweden, especially the counties Skåne (Scania), Västra Götaland and Jönköping. Reports of clinical signs compatible with BOSS were geographically widespread and were reported in most counties. When expressed as a proportion of respondents (see figure 1), the counties Kalmar and Västmanland reported the highest share of clinical signs, whereas the counties Blekinge and Kronoberg reported none.

The distribution of the Swedish cattle population is uneven, with the highest densities located in the southern counties (Figure 2). Survey participation generally reflected this pattern: the counties with the largest cattle populations also contributed with the most responses (Figure 3).

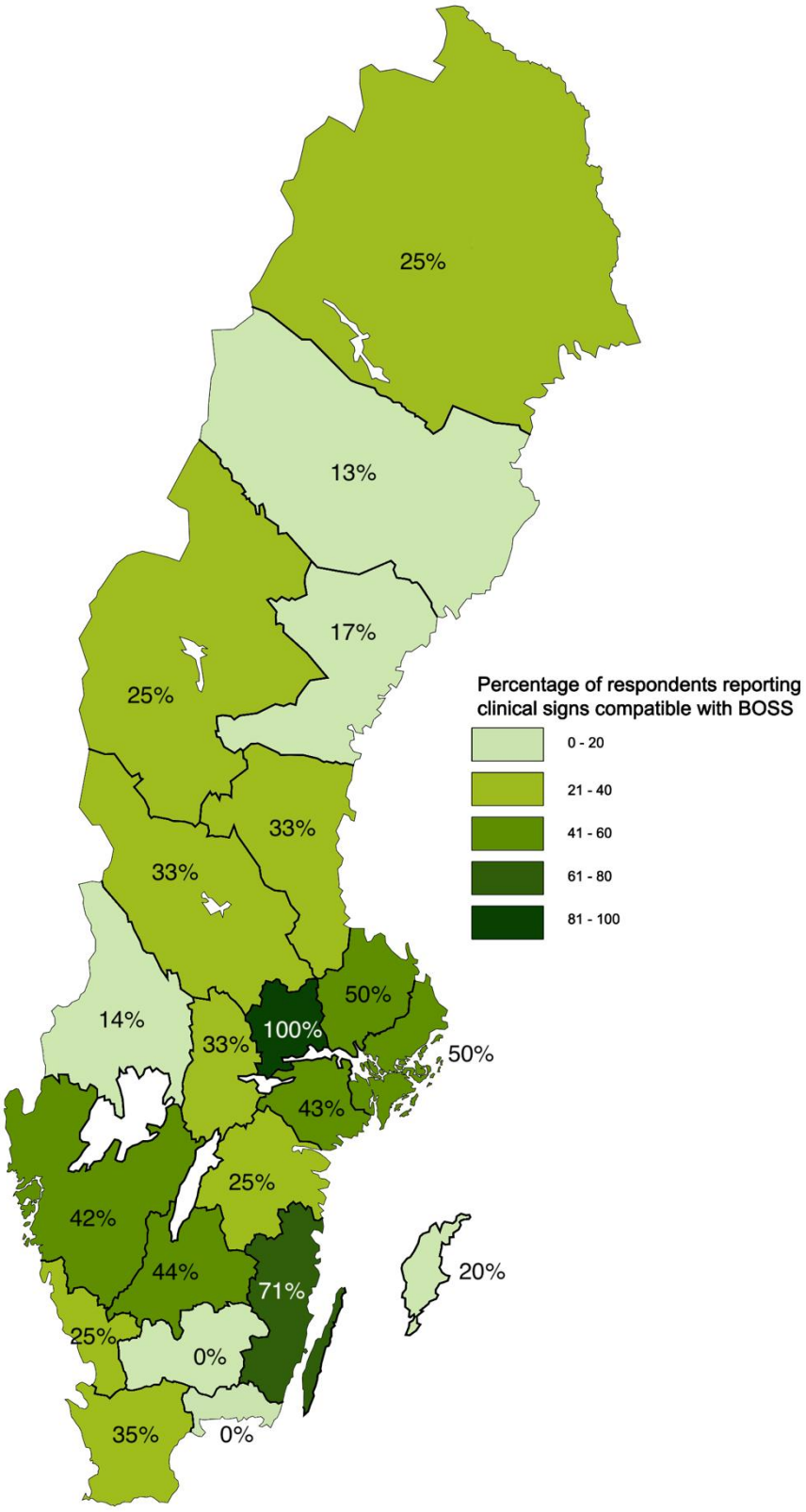

Figure 1. Proportion of survey respondents in each county who reported clinical signs compatible with BOSS. Source of the map: Statistics Sweden

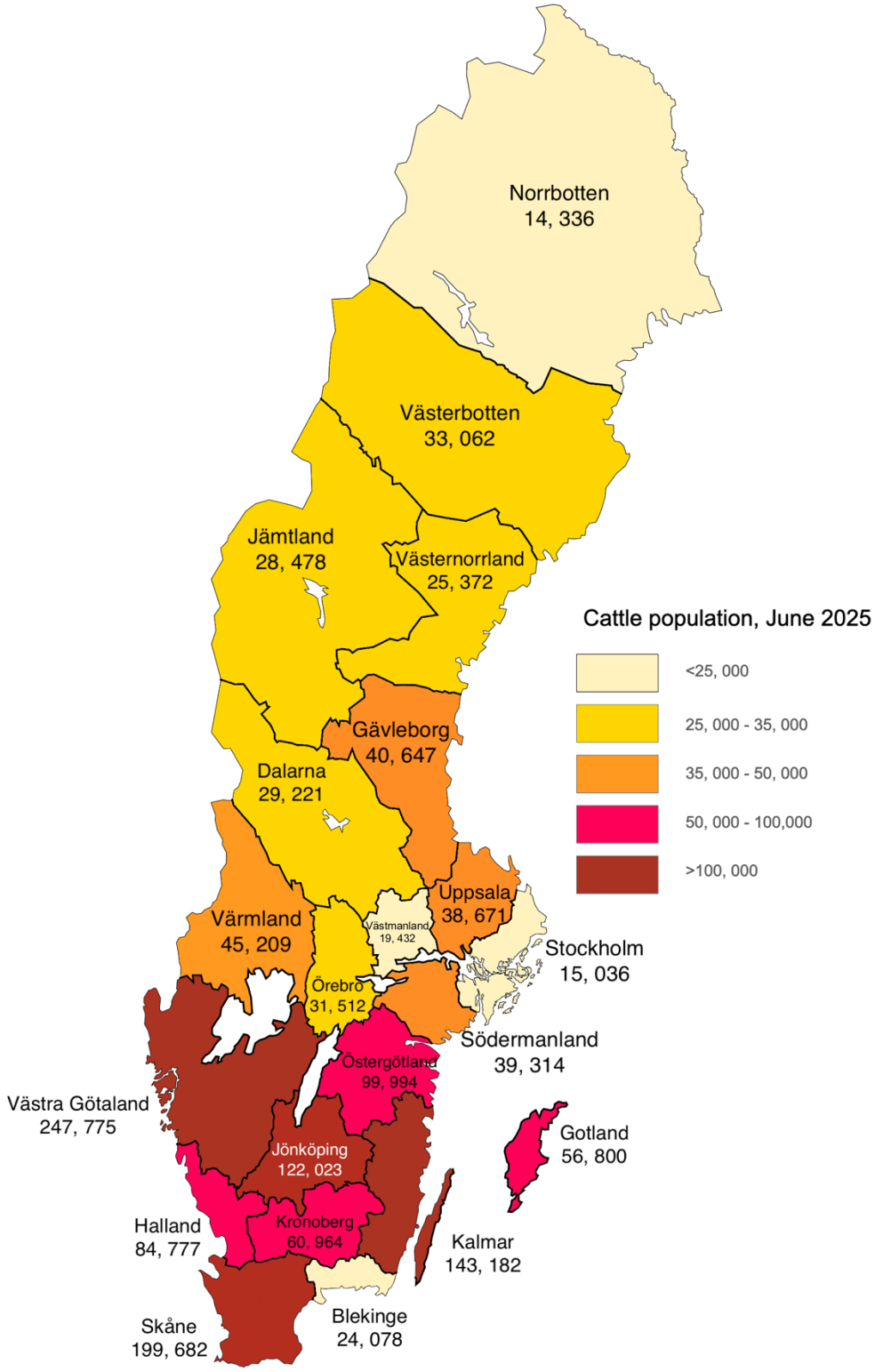

Figure 2. Geographical distribution of the Swedish cattle population by county in June 2025. Counties are shaded according to the total number of cattle, ranging from <25,000 animals (light yellow) to >100,000 animals (dark red). Source of the map: Statistics Sweden

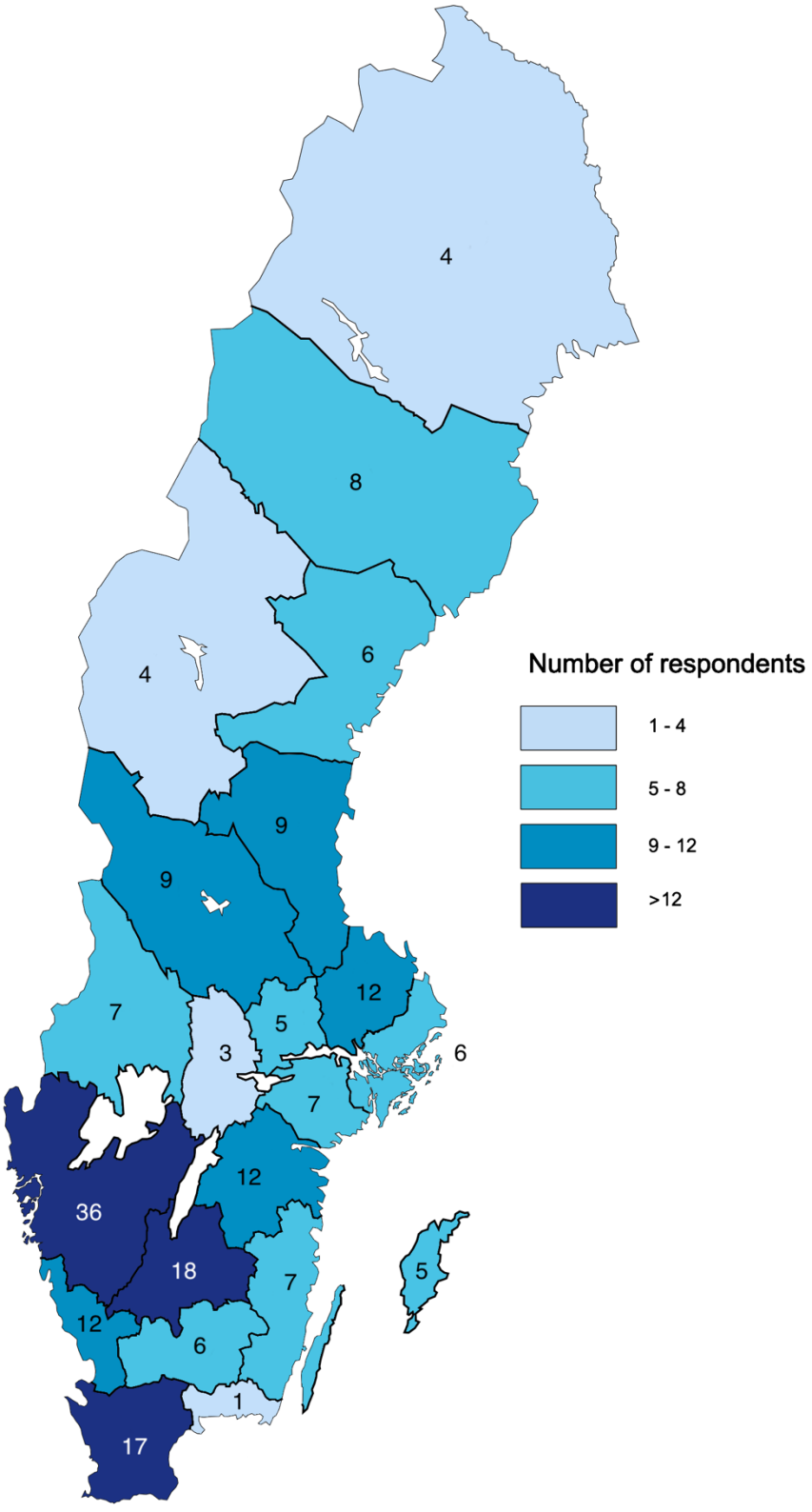

Figure 3. Distribution of survey respondents across Swedish counties (n = 198). Counties are shaded according to the number of farmers who responded to the survey, from 1–4 respondents (light blue) to >12 respondents (dark blue). Source of the map: Statistics Sweden

4.3 Proportion of Respondents Who Observed Clinical Signs Compatible with BOSS

In the first survey question respondents were asked if they had observed animals over three years of age in their herd showing signs of BOSS based on the description and pictures available in Appendix 1. Of the 198 respondents, 117 (60.3%) reported that they had not observed any clinical signs, 71 (36.6%) indicated that they had, and 10 (5.2%) were unsure, see figure 4.

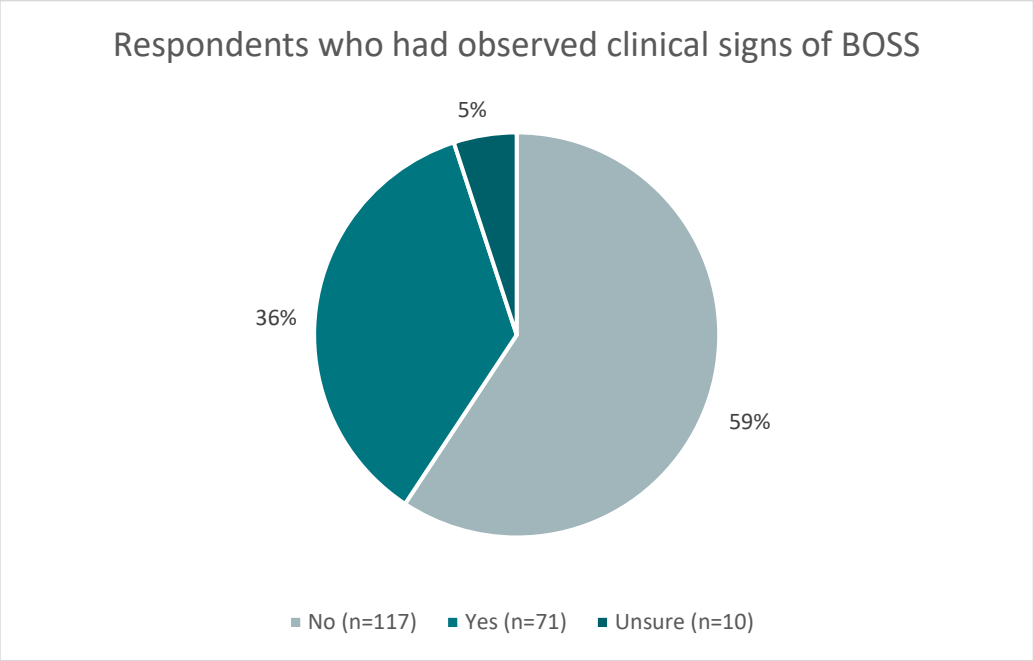

Figure 4. Responses to Question 1 of the national survey of Swedish cattle owners, which asked whether they had observed animals over three years of age showing clinical signs compatible with bovine spastic syndrome (BOSS). A total of 198 respondents answered this question.

4.4 Production and Breeds in Which Clinical Signs Compatible with BOSS Were Observed in Swedish Herds

Reports of clinical signs compatible with BOSS were unevenly distributed across production type. Respondents with dairy herds reported having seen clinical signs to a greater extent than those with beef herds. Overall, 60% of dairy producers indicated that they had observed signs at some point, and dairy herds accounted for 80% of all "Yes" responses (n = 57). In contrast, only 6% of primarily beef producers (n = 4) reported observing clinical signs. Mixed herds fell between

these two extremes. See Figure 5 for the full distribution of responses across production types.

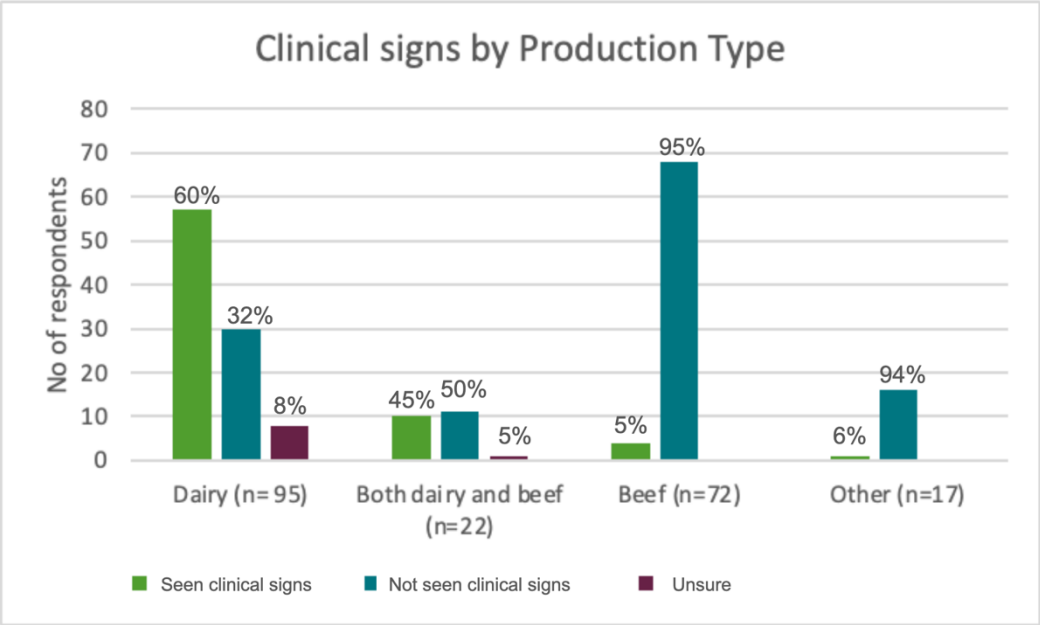

Figure 5. Responses to survey Question 1 regarding whether respondents had observed animals over three years of age showing clinical signs compatible with bovine spastic syndrome (BOSS), grouped by production type. Each respondent selected one of three options ("Yes", "No", or "Unsure"). The figure shows the distribution of responses among herds categorized as dairy (n = 95), mixed dairy and beef (n = 22), beef (n = 72), and other production types (n = 17). Some respondents selected "other" in addition to another production category; therefore, categories are not mutually exclusive. Percentages displayed above each bar represent the proportion of respondents within that production category who selected that response option.

Respondents reported owning a wide range of cattle breeds. In total, 15 individual breeds were represented in the dataset, and many herds contained more than one breed. Overall, 80 respondents owned a single breed, 56 owned two breeds, and 58 owned three or more, including a variety of mixed-breed combinations.

Figure 6 illustrates the proportion of respondents reporting clinical signs compatible with BOSS within each breed category. Clinical signs were most reported in SLB and SRB herds, which were also the most frequently represented breeds in the survey (SLB: n = 94; SRB: n = 80). Among these, 50 SLB herds and 36 SRB herds reported having observed clinical signs. A total of 65 respondents kept both SLB and SRB.

Breed categories varied substantially in the number of respondents, ranging from 8 Limousin herds to 94 SLB herds. Reports of clinical signs were comparatively

rare among beef breeds such as Charolais, Limousin, Hereford, and Highland Cattle, where only isolated cases were observed.

A small number of mixed-breed herds (other than SLB/SRB) also reported clinical signs. These included Procross, Angus-Charolais, SRB-Brown Swiss, and one unspecified SRB mix (each reported once). An additional five respondents indicated clinical signs in mixed-breed cattle but did not specify the breeds involved.

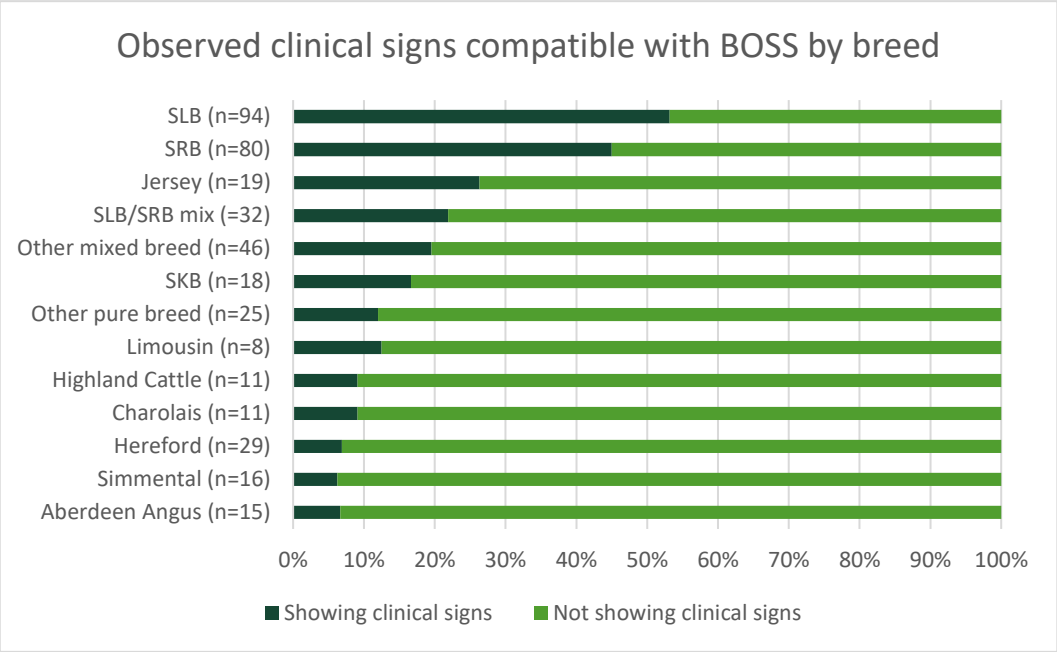

Figure 6. Proportion of respondents reporting clinical signs compatible with bovine spastic syndrome (BOSS) in different cattle breeds. Respondents could select multiple breeds present in their herd, so the total number of breed selections exceeds the number of respondents. "Other pure breed" refers to herds containing purebred animals belonging to breeds not listed individually in the figure (e.g., Dexter and other less common purebred breeds). "Other mixed breed" refers to herds containing mixed or composite breeds other than SLB/SRB mixes, which are shown separately. For each breed category, the figure shows the percentage of respondents who reported having observed clinical signs and those who had not.

4.5 Sexes in Which Clinical signs Compatible with BOSS Have Been Observed

Of the respondents who had observed clinical signs compatible with BOSS (n=71), 62 answered the question regarding the sex of affected animals. The majority of these respondents (n = 58) reported observing clinical signs only in females, two reported observing signs in both males and females, and one respondent reported observing signs exclusively in males.

Information on breed was also available for these observations. Among the respondents reporting clinical signs only in females, most herds consisted primarily of SLB (n=51), SRB (n=40) and/or their crossbreeds (n=17). Jersey cattle were also represented, with a smaller number (n=9) of respondents reporting observations in this breed, along with a limited number of other breeds.

Among the two respondents who reported observing clinical signs in both sexes, one herd consisted of SLB and SRB cattle, while the other consisted of Highland cattle. The single respondent who reported observing clinical signs only in males kept Hereford cattle.

4.6 Experience of Increase in Clinical Signs Compatible with BOSS

A total of 154 respondents answered the question about whether they had noticed an increase in clinical signs compatible with BOSS over the past 5–10 years. This question was posed to all respondents, regardless of whether they had previously observed clinical signs in their own herd. Nineteen respondents reported that they had noticed an increase in clinical signs over this period, while the majority reported no increase (n = 122) or were unsure (n = 13). Among the 64 respondents who reported having observed clinical signs compatible with BOSS, 18 (28%) indicated that the frequency of such signs had increased over time, 36 reported no increase, and 10 were unsure. The results are summarized in Table 1, which presents responses both for the full respondent group and for the subset of respondents with direct experience of clinical signs.

Table 1. Respondents reporting perceived changes in the occurrence of clinical signs compatible with BOSS over the past 5–10 years, shown for all respondents and for respondents with prior observations of clinical signs.

	Increase	No increase	Unsure
Total respondents (n=154)	19	122	13
Respondents that have seen clinical signs in their herds (n=64)	18	36	10

4.7 Replacement Rate

Among Swedish Holstein (SLB) herds, the mean replacement rate was 30.5% (n = 41) in herds where BOSS symptoms had been observed and 28.0% (n = 23) in herds where they had not. The difference was not statistically significant ($t = 1.20$, $df = 41$, $p = 0.24$).

Among Swedish Red (SRB) herds, the mean replacement rate was 30.2% (n = 30) in herds where BOSS symptoms had been observed and 28.4% (n = 25) in herds where they had not. The difference was likewise not statistically significant (t = 1.04, df = 44, p = 0.31). Thus, no significant association between replacement rate and reported BOSS occurrence was found within either breed.

4.8 Farmer-Reported Impacts of BOSS

Of the 71 respondents who had observed clinical signs compatible with BOSS, nine did not answer the follow-up question on consequences. Among the remaining 62 respondents, 60 (97%) reported experiencing one or more negative impacts associated with the condition, while only 2 respondents (3%) indicated that they had not observed any negative effects.

As shown in Figure 7, the most frequently reported consequences were early culling (n = 50), reduced animal welfare (n = 38), and weight loss in affected animals (n = 26). Other commonly reported impacts included stress and anxiety, reduced milk production, lost income, and reduced breeding potential, indicating that respondents perceived the condition to affect both animal health and farm productivity. Two respondents selected "Other"; one clarified this with the free-text comment "avlivning" (culling), while the other did not provide details.

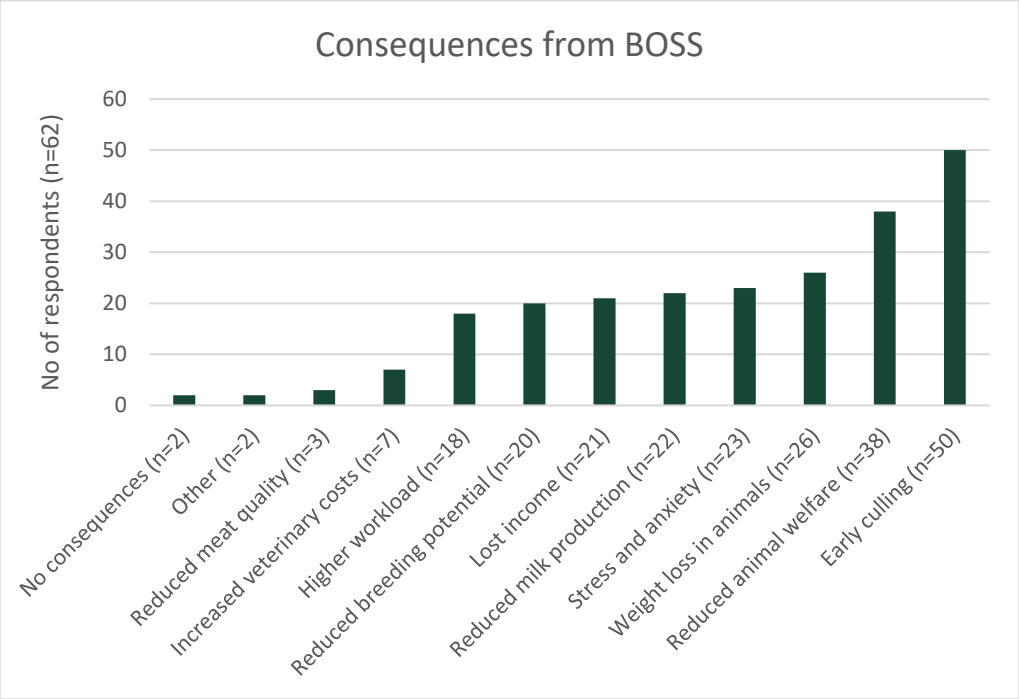

Figure 7. Reported consequences of clinical signs compatible with bovine spastic syndrome (BOSS) in the survey. Only answers from respondents who had observed clinical signs were counted, and multiple consequences could be selected. In total, 62 respondents provided one or more answers. The figure shows how many respondents selected each consequence option.

4.9 Age at Onset of Clinical Signs

A total of 63 respondents reported the age at which cattle usually first showed clinical signs compatible with BOSS (figure 8). Most respondents (n = 52) reported that clinical signs typically appeared between 3 and 5 years of age.

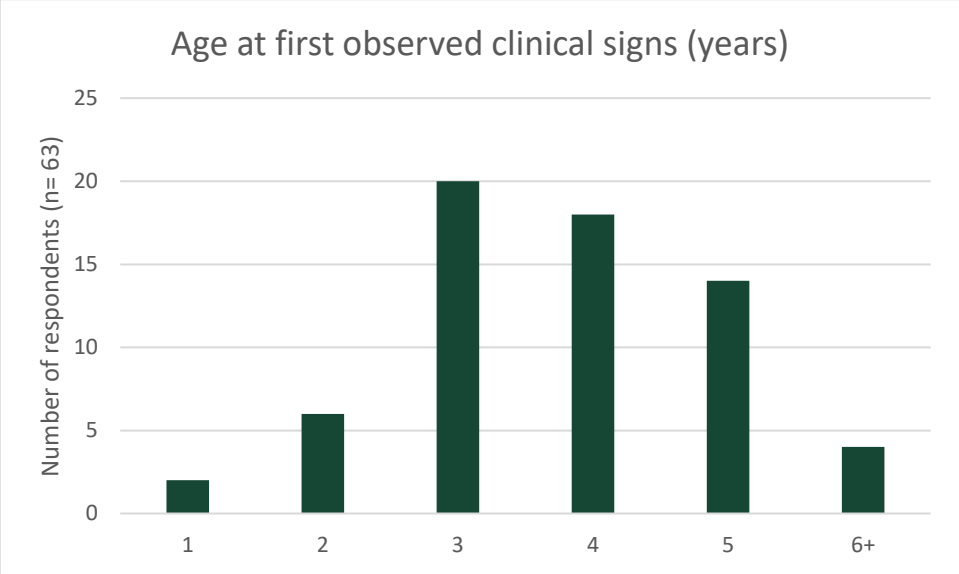

Figure 8. Distribution of reported age at which animals were first observed to show clinical signs compatible with BOSS (n = 63).

4.10 Further interest

56 respondents responded that they were willing to take part in additional studies on the subject, 79 said no and 67 declined to answer the question.

38 respondents provided their contact details for potential follow-up regarding their responses.

5. Discussion

This study used a voluntary online survey to investigate the occurrence and impact of bovine spastic syndrome (BOSS) in Swedish cattle herds. A total of 157 cattle owners completed the survey. They were asked whether they had previously observed clinical signs compatible with BOSS based on a description of these clinical signs as well as photographs and to provide information on the affected animals (production type, age, and breed) as well as any perceived consequences for welfare and herd management. To the best of the author's knowledge this is the first survey-based investigation of BOSS in Sweden.

5.1 Survey Results

5.1.1 Prevalence

The results of the survey suggest that clinical signs compatible with BOSS are perceived as relatively common by Swedish cattle owners. The reported age at onset, most commonly between three and five years, is consistent with previous descriptions of BOSS as a condition with adult onset. More than one third (36%) of respondents reported having observed similar clinical signs in their herd, while an additional proportion were unsure whether they had observed such signs.

In contrast, population-based estimates from Canada indicate a substantially lower overall prevalence, ranging from approximately 0.5% based on routine classify-cation data (Van Doormaal 2013) to 3.6% in a large field study of adult Holstein cattle (Condello et al. 2025), albeit with marked variation between herds. Impor-tantly, these estimates reflect animal-level prevalence at a given time, whereas the present survey assessed the proportion of herds that had ever observed animals showing clinical signs compatible with BOSS. The higher proportion observed in the present survey likely reflects methodological differences, including the small sample size, reliance on farmer perception, inclusion of suspected rather than con-firmed cases, and diagnostic uncertainty, rather than true prevalence. Thus, it is important to emphasize that farmer-reported prevalence does not equate to true prevalence, and the sample size in this study is too small to support definitive pre-valence estimates. This contrasts with estimates derived from national datasets, such as those reported by Van Doormaal (2013) and Condello et al. (2025), which are based on standardized recording systems from the Canadian Dairy Network and substantially larger populations.

The survey relied on respondents' own observations, which introduces potential bias and variation in experience. Although the study provided photos and

descriptions to support identification, the absence of veterinary confirmation means some degree of misclassification cannot be excluded. However, based on the characteristic features presented and the accompanying images, the probability that respondents correctly identified BOSS is high. Conditions that might be confused with BOSS, such as lameness or claw diseases, are generally not associated with spasticity. BSP, while also a cramp disorder, differs in age of onset and clinical presentation, which further supports this interpretation. Confusion with the rarer late-onset form of bovine spastic paresis (BSP), which can occur between two and six years of age, cannot be completely excluded (Goeckmann et al. 2016). Nonetheless, verification of cases, ideally in person but possibly by video or photo, would have strengthened the reliability of reported cases. This was not feasible within the constraints of the present study but can be seen as an opportunity for further improvement of future studies.

5.1.2 Breed and Production

Clinical signs compatible with BOSS were reported more frequently in dairy breeds, particularly among SLB and SRB cattle. When considering relative proportions approximately 53% of SLB herds and 45% of SRB herds reported clinical signs, compared with only 5-10% among most beef breeds. However, SLB and SRB are the most common cattle breeds in Sweden, and many farms keep both breeds; in this survey, 65 respondents reported keeping both SLB and SRB. This overlap limits breed-specific attribution and suggests that reported differences should be interpreted cautiously. Nevertheless, dairy herds accounted for approximately 80% of all reports of clinical signs, whereas only 6% of primarily beef producers reported such observations.

Taken together, these patterns suggest that the occurrence of BOSS or clinical signs compatible with BOSS is disproportionally higher in dairy systems and breeds. Increasing evidence supports a genetic contribution to BOSS susceptibility, particularly in dairy breeds. Previous studies have reported associations between BOSS and high milk production, indicating that long-term selection for production traits may have indirectly increased the frequency of predisposing genetic variants (Goeckmann et al. 2018, Van Doormaal 2013). Dairy populartions, especially Holstein-derived breeds, are characterized by higher levels of inbreeding and a substantial burden of recessive defects linked to intensive selection (Besnard et al. 2024). Recent large-scale genomic analyses have further demonstrated that BOSS is a polygenic disorder with multiple loci of small effect rather than a single causative mutation (Condello et al. 2025). Together, these findings support the interpretation that genetic susceptibility is more common in dairy breeds, potentially explaining the higher reporting rates observed in the present survey.

Differences in management and observation intensity between dairy and beef systems may modify detection probability, but are unlikely to fully account for the magnitude of the observed disparity. Overall, the breed and production type patterns identified in this study are consistent with a model in which BOSS arises from underlying genetic susceptibility, shaped by historical breeding practices and expressed in animals that reach sufficient age and physiological load for clinical signs to manifest.

5.1.3 Geographic Spread

Responses were reported from all Swedish counties, indicating that the syndrome is not confined to a particular geographic area. All counties but two reported at least one incidence of clinical signs compatible with BOSS. However, the apparent differences between counties should be interpreted cautiously. Several regions had very small sample sizes, and survey participation was voluntary rather than random, meaning that that variation in reported occurrence likely reflect differences in response numbers and local engagement rather than true differences in prevalence. The uneven distribution of Swedish cattle, with higher density in the south, almost certainly contributed to both the number of responses and the apparent clustering of reports in those counties.

The most robust conclusion from the maps is the geographical breadth of the syndrome. Clinical signs compatible with BOSS appear across a wide range of environmental contexts, supporting the interpretation of BOSS as a nationally distributed condition rather than a localized phenomenon. At the same time, regional patterns in breeding lines, AI sire usage, and herd structure may still influence local risk and merit further study using more detailed population data.

5.1.4 Reported Impact and Farmer Engagement

Among respondents who had observed clinical signs compatible with BOSS, 97% reported that these clinical signs had negative impacts. The most frequently reported consequences, early culling, reduced animal welfare and weight loss, indicate that farmers perceive this not as a minor or incidental issue but as something with substantial practical and economic implications. Early culling, in particular, represents both a direct financial loss and an ethical concern.

Several additional consequences were reported, illustrating the broad range of challenges associated with the disorder such as reduced milk production, reduced breeding potential and higher workload. A small number reported increased veterinary costs and reduced meat quality. Notably, 23 respondents indicated “stress and anxiety”. The survey did not specify whether this referred to farmer

stress, animal stress, or both. Nevertheless, this response suggests a perceived psychosocial or management burden associated with the condition. Only two respondents reported no consequences. Taken together, these findings indicate that farmers associate BOSS with a multifaceted set of negative outcomes, affecting welfare, productivity, labor demands, and economic performance.

Several respondents perceived an increase in these clinical signs during the past five to ten years. Although such impressions cannot be used to infer true temporal trends, they indicate a growing awareness and possibly increasing concern among farmers. The high response rate to the survey and the large proportion of respondents further confirm the theory that farmers recognize BOSS as an important issue and that they want to contribute to improved understanding and management of the syndrome. It underscores a clear demand for continued research, communication and development of diagnostic tools or preventative strategies.

5.1.5 Replacement Rate

Because BOSS leads to progressive disability, it was hypothesized that herds reporting clinical signs might have higher replacement rates than herds without such reports, or alternatively, that herds with lower replacement rates would have older cows and therefore a higher likelihood of showing age-related disorders. In both SLB and SRB herds, mean replacement rates were numerically higher in herds where BOSS symptoms had been observed than in herds without reported signs, but these differences were small and not statistically significant. Thus, replacement rates in this dataset did not provide evidence supporting either hypothesis.

However, the absence of an indication does not rule out the possibility that age structure could become more relevant in the future. If average cow longevity were to increase, potentially driven by breeding goals aimed at improving durability or by management changes, there may be a growing proportion of older animals in Swedish herds. Since BOSS is a progressive condition a future shift towards an older population could increase the likelihood of observing clinical signs.

5.2 Study Limitations

Several limitations must be considered when interpreting the results of this study. Since this was an online, voluntary survey there was likely a sampling bias. Many respondents were recruited via Facebook, which might have targeted primarily younger or more engaged farmers. However, the advertisement was purposefully neutral to avoid attracting only farmers with prior engagement into BOSS and attracted many respondents that had never seen clinical signs compatible with the disease.

A further limitation is the potential for response bias. Dairy farmers may be more frequently exposed to farming magazines or online resources where BOSS is discussed or where the survey was advertised, whereas beef farmers may be less exposed to these channels. Despite this, the survey reached cattle owners from all Swedish counties and with many different production systems and breeds.

There was also no control for duplicate respondents from the same farm or false responses. The survey was only available in Swedish which may have excluded potential respondents who do not read the language. The questions could have been designed for clearer results. Several responses required interpretation, for example when respondents reported replacement rates in unusual ways or were unclear about which cattle breeds they kept. Some respondents also expressed a desire to add comments or provide additional information, which could have been accommodated through an optional free-text field. 44 respondents did not complete the survey, which may be attributable to factors such as respondent fatigue, uncertainty about the questions or limited relevance of the topic to some respondents.

5.3 Implications and Future Directions

The study highlights several practical and scientific implications. Overall, these results indicate that respondents who had observed clinical signs perceived the condition as having significant impacts on both animal health and farm-level management. These concerns warrant attention from the veterinary community. From a breeding perspective, the concentration of reported cases in SLB and SRB herds, combined with previous evidence for familial clustering and associated genetic variants, is consistent with a potential breed related disposition in Swedish dairy cattle. This pattern should therefore be interpreted cautiously, as it may also reflect differences in observation intensity, management practices, and survey participation between dairy and beef producers. Nevertheless, when considered together with previous studies reporting familial clustering and associations with specific genomic regions, it remains highly suspected that genetic factors contribute to susceptibility in some dairy populations. This interpretation is also supported by other research groups, who have repeatedly proposed a hereditary component to BOSS based on pedigree analyses, breed differences, and genomic associations (Goeckmann et al. 2018, Van Doormaal 2013, Krull et al. 2020). To evaluate this possibility, systematic recording of confirmed cases and integration of genomic data would be required. Such information would help determine whether selective breeding strategies could eventually play a role in reducing the occurrence of BOSS without compromising genetic diversity or production traits.

Further steps to address this may include epidemiological studies to estimate the prevalence or incidence of the disorder, genetic analysis to explore genetic causes or predisposing factors and veterinary field studies to confirm clinical cases. Veterinarians in the field may require further training to recognize the disorder.

Finally, the willingness of many respondents to be contacted for further studies offers a practical basis for follow-up work. The herds identified in this survey could be used for clinical examinations, standardized video documentation of gait and posture, and sampling for genomic and pathological analyses. Such studies would be essential to move from farmer-reported clinical impressions to objectively confirmed diagnoses and to clarify the relationship between BOSS, other neuromuscular disorders, and underlying genetic risk factors.

6. Conclusion

This survey provides the first indication of the presence and apparent distribution of clinical signs compatible with BOSS in Swedish cattle, particularly within the dairy breeds SRB and SLB. Reports were geographically widespread, suggesting that the condition is not confined to specific regions. Importantly, these findings give, for the first time, an initial picture of how common BOSS-like signs may be in these breeds, which can help inform breeding decisions.

The strong interest and willingness among farmers to engage further highlights both the relevance of the issue and the potential for large-scale collaborative studies. With broader and more systematic data collection, future research can better determine the true prevalence, underlying causes, and practical implications of this condition in Sweden. These preliminary results also provide an important foundation for securing targeted funding to investigate causal and predisposing factors in more depth, ultimately supporting the development of effective preventive measures.

References

Becker, R.B., Wilcox, C.J. & Pritchard, W.R. (1961). Crampy or progressive posterior paralysis in mature cattle. *Journal of Dairy Science*, 44 (3), 542–547. https://doi.org/10.3168/jds.S0022-0302(61)89774-9

Besnard, F., Guintard, A., Grohs, C. et al. (2024) Massive detection of cryptic recessive genetic defects in dairy cattle mining millions of life histories. *Genome Biology* 25, 248. https://doi.org/10.1186/s13059-024-03384-7

Brito, L.F., Bedere, N., Douhard, F., Oliveira, H.R., Arnal, M., Peñagaricano, F., Schinckel, A.P., Baes, C.F. & Miglior, F. (2021). Review: Genetic selection of high-yielding dairy cattle toward sustainable farming systems in a rapidly changing world. *Animal: An International Journal of Animal Bioscience*, 15 Suppl 1, 100292. https://doi.org/10.1016/j.animal.2021.100292

Condello, G., Schenkel, F.S., Hermisdorff, I.C., Lynch, C., Rochus, C.M., Van Doormaal, B.J., Miglior, F. & Baes, C.F. (2025). Genetic insights into bovine spastic syndrome (Crampy) in Holstein dairy cattle. *Journal of Dairy Science*. https://doi.org/10.3168/jds.2025-27026

Dirksen, G., Gründer, H.D. & Stöber, M. (2006). *Innere Medizin und Chirurgie des Rindes*. Stuttgart: Georg Thieme Verlag.

Evers, J. (1948). Ist die Krampfigkeit des Rindes dieselbe Krankheit wie die Multiple-Sklerose beim Menschen? *Tierärztliche Umschau*, 3:326.

Frauchiger, E. & Hoffmann, W. (1941). *Die Nervenkrankheiten des Rindes: eine Grundlage für eine vergleichende Neurologie von Mensch und Haustier*. Bern; Verlag Hans Huber.

Gentile, A. & Testoni, S. (2006). Inherited disorders of cattle: a selected review. *Slovenian Veterinary Research*. https://www.semanticscholar.org/paper/Inherited-disorders-of-cattle%3A-a-selected-review.-Gentile-Testoni/d645fc4adb4d354de1ccef605cb9e935a0ecd323 [2025-10-21]

Goeckmann, V., Rothammer, S. & Medugorac, I. (2016). Bovine spastic paresis: A review of the genetic background and perspectives for the future. *The Veterinary Journal,* 216, 64–71. https://doi.org/10.1016/j.tvjl.2016.07.001

Goeckmann, V., Rothammer, S. & Medugorac, I. (2018). Bovine spastic syndrome: a review. *Veterinary Record*, 182 (24), 693–693. https://doi.org/10.1136/vr.104814

Hägglund, S., Ferraro, S., Mansouryan Tabaei, I., Gazeev, S., Olzen, A., Matiasek, K., Olsen, E. & Valarcher, J.F. (2023). Characterisation of bovine spastic syndrome in a dairy herd. *European Buiatrics Congress and ECBHM Jubilee Symposium*, Aug 24-26 2023, Berlin, Germany. Abstract book. Gießen: Verlag der DVG. Poster abstract.

Jacinto, J.G., Letko, A., Häfliger, I.M., Akyürek, E.E., Sacchetto, R., Gentile, A. & Drögemüller, C. (2024). Whole genome sequencing reveals candidate causal

genetic variants for spastic syndrome in Holstein cattle. *Scientific Reports*, 14(1), 31188. doi: 10.1038/s41598-024-82446-z

Krull, F., Hirschfeld, M., Wemheuer, W.E. & Brenig, B. (2020). Frameshift variant in novel adenosine-A1-receptor homolog associated with bovine spastic syndrome/late-onset bovine spastic paresis in Holstein sires. *Frontiers in Genetics*, 11. https://doi.org/10.3389/fgene.2020.591794

Lactanet (2021). *Data Collection Blitz: The Crampy Project*. Lactanet, Canadian Network for Dairy Excellence. https://lactanet.ca/en/data-collection-crampy/ [2025-09-10]

Neustaeter, A. (2015). *Genome-wide Association Studies and Fine Mapping for Spastic Syndrome in Holstein Cattle*. MSc Thesis, University of Guelph.

Neustaeter, A., Brito, L.F., Hanna, W.J.B., Baird, J.D. & Schenkel, F.S. (2023). Investigating the genetic background of spastic syndrome in North American Holstein cattle based on heritability, genome-wide association, and functional genomic analyses. *Genes*, 14(7), 1479. https://doi.org/10.3390/genes14071479

Roberts, S.J. (1953). A spastic syndrome in cattle. *The Cornell Veterinarian*, 43, 380–388.

Roberts, S.J. (1965). Hereditary spastic diseases affecting cattle in New York State. *The Cornell Veterinarian*, 55, 637–644.

Tenszen, A. (1998). Spastic syndrome in a Canadian Hereford bull. *Canadian Veterinary Journal*, 39(11), 716–717.

Van Doormaal, B. (2013). *Current Perspective on Crampiness in Holsteins*. Canadian Dairy Network (CDN), November 2013. [2025-09-10]

Wells, G.A.H., Hawkins, S.A.C., O'Toole, D.T., Done, S.H., Duffel, S.J., Bradley, R. & Hebert, C.N. (1987). Spastic syndrome in a Holstein bull: A histologic study. *Veterinary Pathology*, 24(4), 345–353. https://doi.org/10.1177/030098588702400410

Popular science summary

Cattle can suffer from a neurological disorder called bovine spastic syndrome (BOSS). The condition causes painful muscle spasms, usually in the hind legs, and typically affects older animals. During attacks, cows may stretch their legs stiffly behind them, tremble, or take on a “sawhorse” posture. The disorder gets worse over time and there is currently no cure. Because of this, BOSS can lead to reduced welfare, early culling, and economic losses for farmers.

Although BOSS has been recognized internationally for more than 80 years, very little is known about the disorder. To try to answer if this disorder is a problem in Sweden, a national online survey was distributed to cattle owners in the summer of 2025. The aim was to find out whether farmers had observed signs resembling BOSS in their herds, which animals were affected, what kinds of negative impacts these signs had on welfare or production, and whether farmers felt the situation had changed in recent years.

More than 200 cattle owners responded to the survey from all Swedish counties. About one-third said they had seen clinical signs compatible with BOSS, while a small number were unsure. Most reports of these clinical signs came from dairy herds, particularly those with Swedish Holstein (SLB) and Swedish Red (SRB) cattle. Very few beef producers reported similar signs. Around one in four farmers thought that these signs had become more common in the last 5–10 years. Many farmers who had seen clinical signs said the condition caused real problems. Early culling, reduced animal welfare, weight loss, and production losses were commonly mentioned.

As with any online survey, there are limitations. Reports were based on farmers’ own observations rather than veterinary diagnoses, and farmers vary in experience and familiarity with different conditions. This means the results cannot be used to estimate the true prevalence of BOSS in Sweden. However, the study provides the first nationwide overview of farmers’ experiences and suggests that the condition may be more widespread than previously assumed.

The survey results are important because they point to a disorder that may affect a substantial proportion of Swedish dairy herds, with consequences for both welfare and productivity. Previous international studies suggest that BOSS may have a genetic component, possibly involving multiple genes, which could have implications for breeding strategies.

Encouragingly, many participants expressed interest in further research, and some provided contact information for follow-up. These herds could be valuable for future studies.

Overall, this study shows that clinical signs resembling BOSS are commonly reported by Swedish cattle owners, particularly in dairy herds, and that they can have real consequences for both animals and farmers. More research, better diagnostic awareness, and studies on potential genetic factors are needed to understand how widespread the condition truly is and how it can be managed in the future.

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Appendix 1

Bovint spastiskt syndrom - Ett växande problem?

Denna enkät kommer att ligga till grund för ett examensarbete inom veterinärmedicin vid Sveriges Lantbruksuniversitet. Förhoppningen är att resultaten från undersökningen kommer att kunna användas som underlag till framtida studier om bovint spastiskt syndrom och dess effekter och att förbättra livet för kor i Sverige.

Som lantbrukare får du nu möjligheten att delta i den här enkätundersökningen. Dina svar är lika betydelsefulla för undersökningen vare sig ni haft bovint spastiskt syndrom eller inte i besättningen. Enkäten är helt frivillig och dina svar kommer att vara anonyma.

Har du några frågor om enkäten eller studien? Då kan du kontakta spastisktsyndrom@slu.se.

Tack på förhand.

Vi kommer nu ställa några frågor om symptom på bovint spastiskt syndrom. Med det menar vi djur som uppvisar återkommande anfall av muskulära kramper i bakbenen.

Symtomen inkluderar:

- Muskelkramper i bakbenen, vilket påverkar djurets rörelseförmåga.
- Muskeldarrningar och tillfällig stelhet, som kan sprida sig från bakbenen till bäcken, rygg och i allvarliga fall hela kroppen.
- Onormal kroppshållning, såsom översträckta bakben och krökning av ryggen.
- Tilltagande svårigheter att stå upp och röra sig, särskilt vid ansträngning så som när djuret svänger runt hörn.
- Perioder av förbättring, men sjukdomen förvärras gradvis och kan leda till viktförlust, hälta, ledproblem och behov av tidig utslaktning.

Här är några exempel på hur det kan se ut:

Images shown to respondents to illustrate clinical signs compatible with bovine spastic syndrome (BOSS). Images adapted from Jacinto et al. (2024), Scientific Reports*, https://doi.org/10.1038/s41598-024-82446-z, licensed under CC BY 4.0. Changes were made (cropping).*

Denna enkät är endast för dig som äger nötkreatur i Sverige.

1. Har du sett djur äldre än tre år i din besättning uppvisa tecken på bovint spastiskt syndrom?
   - Ja
   - Nej
   - Vet ej

2. I vilket län finns besättningen?
   - Blekinge län
   - Dalarnas län
   - Gotlands län
   - Gävleborgs län
   - Hallands län
   - Jämtlands län
   - Jönköpings län
   - Kalmar län
   - Kronobergs län
   - Norrbottens län
   - Skåne län

- Stockholms län
- Södermanlands län
- Uppsala län
- Värmlands län
- Västerbottens län
- Västernorrlands län
- Västmanlands län
- Västra Götalands län
- Örebro län
- Östergötlands län

3. Hur många årskor finns i besättningen 2025?

4. Vad är besättningens inriktning?
   - Mjölk
   - Kött
   - Båda
   - Annat:

5. Vilken ras har dina kor?

Om du har mer än en ras, renrasiga, välj då mer än ett alternativ.
Om du har korsningskor, välj korsning och fyll gärna i kommentarsfältet med vilka raser.

- Aberdeen angus
- Charolais
- Hereford
- Highland Cattle
- Jersey
- Limousin
- Simmental
- Svensk låglandsboskap (SLB) / Holstein
- Svensk rödbrokig boskap (SRB)
- Svensk kullig boskap
- Annat
- SLB / SRB korsning
- Korsning av:

6. Vad har din besättning för rekryteringsprocent 2025?

7. Har du upplevt att förekomsten av bovint spastisk syndrom har ökat i din besättning de senaste 5-10 åren?
   - Ja

- Nej
- Osäker

8. Hur många djur som är äldre än tre år har uppvisat symtom på bovint spastiskt syndrom de senaste fem åren?

9. Har du upplevt några konsekvenser till följd av bovint spastiskt syndrom?
   - Minskad mjölkproduktion
   - Viktförlust hos djuren
   - Försämrad djurvälfärd
   - Ökade veterinärkostnader
   - Tidig utslaktning
   - Minskad avelspotential
   - Försämrad köttkvalitet
   - Förlorade inkomster
   - Högre arbetsbelastning
   - Stress och oro
   - Inga konsekvenser
   - Annat:

10. Hos vilka djur har du sett symtom de senaste fem åren?
    - Kor
    - Tjurar
    - Stutar
    - Kvigor
    - Ungdjur
    - Kalvar

11. Vid vilken ålder brukar du oftast se att djuren först uppvisar dessa symom?
    - Innan ett års ålder
    - 1
    - 2
    - 3
    - 4
    - 5
    - 6+

12. Om du har flera raser: hos vilka av dem har du sett symtom på bovint spastisk syndrom? (Ange raser i fritext. Om du bara har en ras, lämna detta fält tomt.)

13. Om du vill ha information om resultaten från studien fyll i din email adress/telefonnummer nedan. Vi kan komma att kontakta dig om dina svar på frågorna i enkäten.

14. Kan du tänka dig vara med i ytterligare studier om ämnet?
    - Ja
    - Nej

Om du vill kontakta oss, ställa frågor om bovint spastisk syndrom eller studien kan du kontakta oss på mailen nedan.

Vi tar jättegärna emot bilder på djur med bovint spastisk syndrom, alla bilder kommer vara helt anonyma och endast användas i utbildnings- och forskningssyfte.

spastisktsyndrom@slu.se

Appendix 2

Advertisement image used to promote and distribute the survey to cattle owners. The layout and text were created by the author, icons/images included are used under their respective licences.

Appendix 3

Advertisements for the survey were posted in the following Facebook groups targeting Swedish farmers and cattle owners:

BÖNDER SOM KAN TÄNKA SJÄLVA
Jersey kor
Kor i liten skala
Lantbrukaren
Lantbruksdjur till sällskap
Skaraborgs Herefordklubb
SRB-klubben
Sveriges Bönder!
Sveriges Mjölkbönder
Vi Med Dexter 🐮
Vi med robot
Vi som har dikor och ungdjursuppfödning
vi som har fjällkor
Vi som har Fjällnära besättning
Vi som har Highland Cattle
Vi som har kor
vi som älskar fjällkor och andra svenska/norska lantraser

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