ASSESSMENT OF ANIMAL WELFARE IN MINK FARMS - BASED ON THE WELFUR-MINK PROTOCOL

BRITT INGEBORG FOSEIDE HENRIKSEN
PhD THESIS · SCIENCE AND TECHNOLOGY · 2015

AARHUS UNIVERSITY
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Cover photo: Jesper Clausen, Kopenhagen Fur
Preface

The present PhD thesis entitled “Assessment of animal welfare in mink farms - based on the WelFur-Mink protocol” is based on work carried out from April 2012 to March 2015 at the Department of animal Science, Faculty of Science and Technology, Aarhus University, where I have been part of the section Epidemiology and Management. Funding was provided by Aarhus University and European Fur Breeders Association as part of the WelFur project.

This PhD study has resulted in three research papers. Paper I, entitled “The reliability of welfare assessment according to the WelFur-protocol in the nursing period of mink (Neovison vison) is challenged by increasing welfare problems prior to weaning” is published in Animal Welfare. Paper II, entitled “Classification of animal welfare on mink farms differs between three annual production periods” has been accepted for publication in Animal Welfare and Paper III “Farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare” has been submitted to Livestock Science.
Acknowledgement

Several people have contributed to the completion of this PhD study, and I am deeply grateful to you all. First, I would like to express my sincere gratitude to my main supervisor, senior researcher Steen Henrik Møller and my co-supervisor professor Jan Tind Sørensen, who introduced me to the interesting world of mink. I have been both challenged and fascinated by the complexity of the production system, and have enjoyed doing research within the field. Thank you Steen and Jan for your support and guidance, both in planning and completion of the practical studies and in the writing process of articles and thesis.

I want to thank the farmers, who participated in the project for their co-operation, hospitality and contribution with information. Without your contribution, this study would not have been possible. I also want to thank the veterinarians, who helped me with selecting farms. Thank you to Maria Sylvest Blæsbjerg from Kopenhagen Advice, Kopenhagen Fur, for many hard working hours on all the farm visits and for sharing your knowledge and experience. I also want to thank Bente Krogh Hansen, also from Kopenhagen Advice, Kopenhagen Fur and Birthe Houbak, Steffen Werner Hansen and Jens Malmkvist from Aarhus University, Department of Animal Science, for contributing with data collection on mink farms and sharing of your practical experiences and knowledge within mink production and research. Thank you to the European Fur Breeders Association and Aarhus University for financing the PhD study.

I want to thank Anna Feldberg Marsbøll for the time spent on proof reading the thesis. I am really grateful for your comments and suggestions, and hope we can continue our professional collaboration. I want to thank Rodrigo Labouriau for statistical consultation and introducing me to R, Tina Albertsen for English proof reading of the thesis and Mette Holme for always being helpful with all kinds of practical problems during my PhD. I want to thank all my colleagues in the Epidemiology and Management group for an inspiring research environment and positive attitude. I have really enjoyed being a part of the group. A special thanks to my office mate Siwi Gayatri, for always being positive and encouraging, and so often brightening my day with a piece of cake.

Thank you to friends and my family, both in Norway and Denmark for your great support, both practical and mental. I am deeply grateful. And, last but not least, my deepest love and sincere gratitude to my husband, Thomas, and my children, Anna and Magnus. You have been very patient and have supported me in my ups and downs. I really look forward to spending some more time with you again.
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Summary

Mink production is strictly synchronised and all animals follow the same annual cycle, with three main phases of production: 1) preparation of breeders in winter, 2) reproduction and nursing in spring and early summer and 3) growth of kits until pelting time in autumn. There are different welfare challenges both within and between the three phases of production, but the farm manager will typically be the same. The purpose of research on assessment of mink welfare in this PhD study was to contribute with methods and knowledge on how to get the assessment as efficient and correct as possible and how to use these assessments in order to increase the welfare of the animals.

The overall aim of this PhD study was to evaluate the welfare assessment protocol WelFur-Mink and evaluate stable schools as a system that utilises the knowledge and experiences among farmers, in order to improve mink welfare. WelFur-Mink is based on the principles developed in Welfare Quality®, with assessed measurements being aggregated into scores across the three production periods, then for 12 criteria, four principles and an overall classification per farm. Stable schools are a special kind of discussion groups where the farmers are working towards a common aim. There is no external expert involved, but the farmers giving practical farm specific advice to each other, with a facilitator leading the process.

The hypotheses of the PhD thesis were: i) In the nursing period, the prevalence of four animal-based measures changes so much with the date of the assessment, that it influences the WelFur scores at criteria level, but not at higher levels (Paper I); ii) The overall annual welfare classification of a mink farm in the welfare assessment system, WelFur, can be based on assessments in only one of the three annual production phases (Paper II); iii) It is possible, based on qualitative interviews, to explore how farmers perceive stable schools as a tool to improve farm management for the benefit of mink welfare (Paper III). Data were obtained from three studies and the results are presented in three scientific papers.

The first study evaluated changes in WelFur scores of mink welfare on four farms, in the nursing period in year 2012. The four measurements, “Mink dam’s body condition”, “Frequency of dirty nests”, “Frequency of injuries”, and “Diarrhoea”, changed with days post-partum. These changes resulted in a change in score values of the related criteria, but not in the estimated overall classification of the farms. Estimation of a WelFur score per principle did also indicate a change with date of assessment. The hypothesis i was only partially accepted due to changes at the principle level but not in the overall classification. The study shows that some of the principle score
values were close to the borderline for higher or lower classification, and changes in the overall WelFur classification could occur if measures had changed to a lower or higher score.

The second study evaluated the welfare of mink in the three different phases of production, on 19 mink farms (nine farms in 2011 and ten farms in 2013), according to the assessment system WelFur-Mink. The results showed that the estimated WelFur-classification in the three assessment periods differed, and that there was a high correlation between the overall annual WelFur scores and the estimated score values in assessment period 2 and 3 for the WelFur principles. There were correlations between the full annual WelFur score and several criteria scores related to the different principles. The hypothesis $ii$ was rejected as the overall classification of a farm could not be based on assessment in only one of the three production phases. The results imply that assessment period 2 and 3 gives enough information to calculate the overall annual welfare and that it might be possible to exclude the assessment in period 1. The results do further imply the possibility of reducing the number of measurements in the different periods.

The third study evaluated stable schools as a tool in mink production by qualitative interview of farmers from 10 farms that had joined stable schools for one year. The interviews revealed several aspects of how stable schools can be used as a tool for improving farm management for the benefit of mink welfare, and the hypothesis $iii$ was accepted. The interviews showed that farmers are generally positive to the structural way of working in stable schools, and that motivation for working towards a common goal is important. The uniform production system at mink farms gives special challenges in how to work with the different subjects to ensure farmer ownership of the process. The farmers did not see the seasonal production as any constraint, but express that they like to work with the specific problems and challenges related to the respective production periods, and WelFur could be useful inputs to the group.

The findings of this PhD study show that it is possible to reduce the assessment procedure WelFur-Mink without jeopardising the validity of the assessment of mink welfare on farms, taking the potential risk of change in score values within the nursing period into account. Stable schools can be a useful tool to encourage improvements of animal welfare on mink farms, and results from WelFur assessments might be useful information to bring into the group. However, the results are provided under Danish conditions and in order to evaluate the effect of different climatic conditions, feeding, housing and management practices information from WelFur assessments on a larger number of farms from different countries should be analysed.
Sammendrag (Danish summary)


Hypoteserne for ph.d.-studiet var; i) Forekomsten af fire dyre-baserede velfærdsparametre ændrer sig så meget med datoen for vurderingen, at de påvirker WelFur scoreværdierne på kriterieniveau, men ikke på de højere niveauer (Artikel I); ii) En overordnet klassificering af farme i forhold til dyrevelfærd kan baseres på velfærdvurdering i kun en af de tre årlige faser i produktionen (Artikel II); iii) Det er muligt, via kvalitative interviews, at undersøge avlernes opfattelse af staldskoler som et redskab til at forbedre management til fordel for minkens velfærd. Der blev gennemført tre studier, og resultaterne herfra er præsenteret i tre videnskabelige artikler.

så den overordnede WelFur-klassificering kunne ændres ved blot lidt højere eller lavere scoreværdier af nogle af velfærdsindikatorerne.


Det tredje studie evaluerede staldskoler, som et redskab i minkproduktion, via kvalitative interviews af avlere fra ti farmer, som havde deltaget i et års staldskoleforløb. Interviewene afdækkede flere aspekter af, hvordan staldskoler kan bruges som et redskab for at forbedre management til fordel for dyrenes velfærd, og hypotese iii blev accepteret. De forskellige interview viste, at avlere generelt er positive overfor den strukturerede måde at arbejde på i staldskolerne, og at motivation for at arbejde mod et fælles mål er vigtigt for fælles læring mellem avlere i gruppen. Minkproduktionens ensartede produktionsform giver nogle særlige udfordringer i forhold til, hvordan der kan arbejdes med de forskellige temaer for at sikre avlernes ejerskab over processen. Avlere så ikke den sæsonbaserede produktion som nogen begrænsning, men udtrykte at de gerne vil arbejde med specifikke problemer og udfordringer relateret til de respektive produktionsperioder, og de så resultater fra WelFur som nyttige input til gruppen.

Resultaterne fra denne afhandling viser, at det er muligt at reducere vurderingsproceduren WelFur-Mink, uden at gå på kompromis med validiteten af velfærdsvurderingen af farmer, og samtidig tage højde for potentielt risiko for ændring i scoreværdi indenfor dieperioden. Staldskoler kan være et nyttigt redskab til at motivere til en forbedret dyrevelfærd på minkfarmer, og resultater fra WelFur-vurderinger kan være nyttig information at bringe ind i gruppen. Resultaterne fra studierne i afhandlingen er fremskaffet under danske forhold. For at evaluere effektforskelle i vejrforhold, fodrings-, indhusnings- og managementpraksis i relation til resultaterne fra denne afhandling, bør information fra WelFur-vurdering af et større antal farme fra forskellige lande analyseres.
List of included papers

Paper I
The reliability of welfare assessment according to the WelFur-protocol in the nursing period of mink (Neovison vison) is challenged by increasing welfare problems prior to weaning
Henriksen BF and SH Møller
ISSN 0962-7286, doi: 10.7120/09627286.24.2.193

Paper II
Classification of animal welfare on mink farms differs between three annual production periods
Henriksen BIF, JT Sørensen and SH Møller
Animal Welfare, accepted

Paper III
Farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare
Henriksen BIF, I Anneberg, JT Sørensen and SH Møller
Livestock Science, submitted
1 Introduction

1.1 General introduction

Mink farming is an agricultural production taking place mainly in Europe, China and North America (53%, 39% and 8% in 2014, of worldwide mink production) (Kopenhagen Fur, 2015). In Europe, the main production of mink is located in Denmark, Poland and the Netherlands. Denmark is the largest producer of mink pelts in Europe with about 3.3 million breeding mink females on 1472 farms in 2014 (Clausen, 2014). In 2014, about 17.9 million mink skins were produced in Denmark (Kopenhagen Fur, 2015). Approximately 98 per cent of the skins sold at Kopenhagen Fur Auction are exported, and fur ranges as Danish agriculture’s third largest export article and is an important industry in Denmark.

The animals’ welfare on production farms has been of increasing concern, especially among European consumers (European Commission, 2007; Centner, 2010). Different campaigns, footage and demonstrations from animal right organisations have especially led the mink industry into public attention. The public view on mink production seems to be diverse, with some people seeing mink farming as an animal production that should be evaluated and judged in line with other animal productions, and other people seeing the purpose of the production as crucial to the ethical evaluation of the production (Det Dyreetiske Råd, 2003; Ipsos Public Affairs, 2013). The attitudes towards animal use are complex and are species-specific, influenced by factors relating to views and beliefs concerning the type of animal involved, the purpose of animal use, and knowledge of animal use practices (Knight and Barnett, 2008). The great attention and criticism towards the welfare of farmed animals in general, and fur animals in particular, have led to a need for tools to both improve and control animal welfare on mink farms.

Mink production follows a fixed annual cycle with three different major phases of production (Figure 1). The production system is strictly synchronised in which all animals follow the same annual cycle. This differs from e.g. dairy, pig and poultry production where all phases of the production are usually present at all times of the year. In mink production, the first phase is the preparation of breeders from selection in November to mating in March (phase 1). The second phase is reproduction from mating in March to separation in July (phase 2), and the third phase is the growth of kits from separation to pelting or selection for further breeding (phase 3).

Mink are solitary animals spending the majority of their lives in nature without contact with conspecifics, except when caring for offspring and during mating. They are territorial and defend
their territory against other animals and especially against conspecifics of the same sex. This is a challenge when housing mink in order to avoid stress and aggression.

There are different welfare challenges in the three phases of mink production, and methods to assess the animals’ welfare on the farms can be useful in order to identify the extent of different welfare problems. The optimal period for assessing the animals’ welfare within each period is found to be only six to eight weeks long (Mononen et al., 2012).

There are different initiatives aiming at improving the welfare of farm animals, like discussion groups, advisory services, breeding programmes, certification or control of compliance with different regulations or legislations. In mink production, a welfare assessment system for management and advisory purposes was developed and tested in Denmark during 1998 to 2002 (Møller et al., 2003) but has not been implemented in the industry. The development of WelFur was initiated by the European Fur Breeders’ Association (EFBA) in 2009 in order to create a solid certification program to cover all European mink and fox farms. The WelFur project has developed welfare assessment protocols for both foxes (WelFur-Foxes) and mink (WelFur-Mink) and is based on concepts developed in the European Welfare Quality® project working with score values for 12 welfare criteria, four welfare principles and an overall classification of farms’ welfare. The protocols will be printed in a corrected version after initial tests and will be tested in several countries before it is planned to be implemented in the industry (European Fur Information Center, 2014).

Despite the identification of risk factors for reduced animal welfare, the actual change in animal welfare by implementing changes in management and housing conditions is often inadequate (Valeeva et al., 2007; Whay, 2007; Whay and Main, 2010). Therefore, there has been an increasing focus on how to achieve actual intervention and welfare improvements on farms (Whay, 2007; Tremetsberger and Winckler, 2015). Comprehensive animal health and welfare planning, with a great focus on a continuous process and farmer ownership of the process (Nicholas et al., 2008), have shown promising results regarding on-farm changes and animal welfare improvements (Vaarst et al., 2011; Ivemeyer et al., 2012). Stable school is a method used to exchange knowledge between farmers working towards a common goal (Vaarst et al., 2007) and builds on the same approach as the comprehensive animal health and welfare planning. Stable schools have not been tested in mink productions and differ from many other discussion groups by not having any other experts involved than the farmers themselves and a facilitator leading the process.
1.2 Purpose, aim and hypothesis

The purpose of research on assessment of animal welfare on mink farms in the PhD study was to contribute with methods and knowledge on how to get the assessment as efficient and correct as possible and how to use these assessments in order to increase the welfare of the animals. The overall aim of this PhD study was to evaluate the welfare assessment protocol, WelFur, developed for the strictly synchronized mink production system and to evaluate stable schools as a system that utilises the knowledge and experiences among farmers, in order to improve animal welfare in these systems.

The hypotheses of the PhD thesis were:

I. In the nursing period, the prevalence of four animal-based measures changes so much with the date of the assessment, that it influences the WelFur scores at criteria level, but not at higher levels. (Paper I)

II. The overall annual welfare classification of a mink farm in the welfare assessment system, WelFur, can be based on assessments in only one of the three annual production phases. (Paper II)

III. It is possible, based on qualitative interviews, to explore how farmers perceive stable schools as a tool to improve farm management for the benefit of mink welfare.

With the research question: How do farmers perceive stable schools as a tool to improve management for the benefit of mink welfare?

(Paper III)

To test the hypothesis, the objectives of this thesis were to: examine changes during lactation in the welfare scoring of mink according to the WelFur-Mink protocol (Paper I), investigate whether a welfare assessment according to the WelFur-Mink protocol in only one of the three production phases produces a reliable assessment of the welfare in a full annual production of a mink farm (Paper II) and to explore the farmers’ perception of stable schools as a tool to improve farm management for the benefit of mink welfare (Paper III).
Outline of the thesis

A state-of-the-art (Chapter 2) gives an overview of relevant information and literature as a background for the central hypothesis and research question in the thesis. Methodological study considerations are discussed in the following chapter (Chapter 3) before the results of the thesis are presented as three papers investigating the three hypotheses (Chapter 4). The results presented in the three papers are further discussed in relation to the hypothesis and the overall aim of the thesis with a general discussion of the methods (Chapter 5). Finally, an overall conclusion of the thesis is presented (Chapter 6) and further research perspectives are discussed (Chapter 7).
2 State-of-the-art

This chapter gives a brief introduction to mink production with emphasis on housing conditions and welfare challenges of the mink in the three phases of the production. The chapter further gives examples on assessment systems based on resource-based and animal-based welfare measurements before different welfare definitions are described as an introduction to WelFur’s approach to animal welfare. The chapter ends up with how welfare assessment can be part of on-farm health and welfare planning and explains the concept of stable schools as a possible tool to implement welfare improvements on mink farms.

2.1 Mink production

Mink are seasonal breeders, and the change in day length and exposure to adequate light are important for natural reproductive and furring cycles (Sundqvist et al., 1989). The production of mink is therefore synchronised within and between farms with three distinguished seasonal phases of production as illustrated in Figure 1.

Mink are typically housed in wire mesh cages elevated from the ground. The cages are positioned next to each other inside open or closed sheds. All cages have a nest box and these must be provided with suitable bedding and occupation material (e.g. like straw), often by regulation, e.g. as

![Figure 1. The three seasonal phases of mink production.](image-url)
for European and Canadian farms, (Council of Europe, 1999; National Farm Animal Care Council, 2013). Environmental enrichments can be defined as “the addition of physical or social stimuli to animals’ captive environments to improve their welfare” (Meagher et al., 2014). Several environmental enrichments are found to be positive for the mink’s welfare (e.g. Hansen et al., 2007; Meagher et al., 2014). Environmental enrichment for mink is required in several countries (National Farm Animal Care Council, 2013), and according to Danish regulations, every cage shall as a minimum be provided with the enrichments: a shelf, a plastic tube (except in the nursing period) and straw (Ministry of food, 2013).

Mink are solitary animals with a natural territory of around 2-5 km for the male animals and 1-3 km for female animals (Gerell, 1970). Therefore, both male and female breeders are housed in separate cages in production phase 1 from December to the end of February. In production phase 2, from March to July, most of the males and unmated female breeders will be pelted, while mated females will be housed alone during gestation and with their litters during lactation. In nature, the male and female territory may overlap, and in production phase 3, from weaning to pelting, mink are usually housed pairwise, one female and one male kit or a mother with one of her male kits together. In Europe, it is allowed to keep three or more mink together in group-housing systems, typically in climbing cages (see Figure 2). In group housing, there are typically three or four kits, mainly female kits, or an adult female with one or two male kits in one cage. Mink are semiaquatic carnivores with their natural habitat near water eating rodents, fish, crustaceans, frogs, eggs and birds. The main feed ingredients used in the production are fish, slaughter offal and carbohydrates from cash crops.
Due to the seasonal production, the farm manager will typically be the same person in all three phases of the production. Even if farmers have seasonal workers, the responsible manager will most often be the same. Therefore, the impact of management on animal welfare in mink farms can be expected to be somewhat constant over the annual production cycle.
State-of-the-art

There are different welfare challenges both within and between the different production phases. In phase 1, the major welfare challenge is related to feeding. Before pelting in November, both male and female mink have been fed ad libitum and might have a high body weight and a body condition score (BCS) around 4 – 5 (Hansen et al., 2009). Animals should be in moderate body condition score (BCS) 2 before mating in order to be able to reproduce well and for the females to respond well to flushing (a short period of restricted feeding followed by ad libitum feeding) (Tauson, 1993). The breeders are, therefore, often fed restrictively during the winter and until flushing in late February. The weather condition has great impact on the mink’s metabolism, and a suddenly drop in temperature can result in very thin animals in the period before flushing (Møller, 1992). There is also an increased risk of stereotyping animals in this period due to restricted feeding (Bildsoe et al., 1991; Hansen and Damgaard, 2009).

In production phase 2, there is a risk of very thin dams due to the high milk production and mobilisation of body reserves from after four weeks of lactation when the dam reaches an upper limit for feed consumption (Hansen, 1999) and the milk production exceeds energy consumption (Fink et al., 2001; Fink et al., 2004; Fink et al., 2006). Before the kits start to eat solid food at about four weeks of age, there is a risk of getting the disease ‘sticky kits’, which is caused by an Astro or Calici virus causing diarrhoea and excessive secretion from the cervical apocrine glands (Clausen and Dietz, 2000; Englund et al., 2002; Mittelholzer et al., 2003; Hammer et al., 2012). When the kits start to eat solid food around four weeks post-partum, the mink are usually fed on the lid of the nest box to ease the kits’ access to the feed. This increases the risk of dirty nests, decreased thermal comfort and decreased resting quality of the nest box. After four weeks of age, the risk of “normal” diarrhoea caused by coli or other bacteria increases. The kits start to drink water at about six weeks of age (Moller and Lohi, 1989; Brink and Jeppesen, 2005). The kits’ need for water increases until they manage to drink themselves, and there is a risk for saliva licking from the dam’s mouth and aggression and injuries among the kits (Moller and Lohi, 1989; Brink et al., 2004; Brink and Jeppesen, 2005; Clausen, 2011).

In production phase 3, the kits are housed together with other kits or with their mother and are fed high energy feed. Therefore, the risk of very thin animals is low in this period. On the other hand, high feed intake and body weight gain in the growth period from summer to moulting in October/November are normal both in the wild and in production. This might result in considerable deposits of body fat (Enggaard Hansen et al., 1982) and an increased risk of ‘fatty liver’ (Dick et al., 2014). Juvenile mink need each other’s company to develop reproductive skills (Hansen et al., 1997). As the kits become older they will become more aggressive, which in nature would cause
dispersal of the litter and establishment of individual territories (Dunstone, 1993). However, in captivity, this might lead to injuries. In farming systems, the male-female pairs seem to accept the territorial overlap and to establish a hierarchy with the much larger male being dominant (Gerell, 1970; Birks, 1981; Dunstone, 1993; Møller et al., 2004). In group housing, with three or four animals, there is an increased risk of aggression (Pedersen et al., 2004; Hansen and Møller, 2012; Hansen et al., 2014) which is probably territorial between juveniles of the same sex. Furthermore, it might be difficult to establish a hierarchy between mink of the same sex, and thus same size, and the risk of injuries increases especially after the autumn equinox in such groups (Hansen et al., 2014).

The different risks of impaired welfare, both between and within the three productions, can be a challenge when assessing the animals’ welfare and should be taken into account when certifying or benchmarking farms.

2.2 Welfare assessment systems

A growing concern about the animals’ welfare, especially in Europe (European Commission, 2007; Centner, 2010), has led to development of several systems for assessing the welfare of farmed animals. The different assessment systems are based on information from several measurements from the respective farms. The measurements can be resource-based or animal-based. Resource-based measurements are measurements describing the animals’ surroundings like housing conditions, access to resources and management. Animal-based measurements describe the single animal like the animal’s health and behaviour (EFSA Panel on Animal Health and Welfare, 2012).

One of the early on-farm assessment systems, the “Tiergerechtheitsindex TGI35L (Bartussek, 1999), was mainly based on resource-based measurements looking at the impact of the housing system on the animals’ welfare. In this system, the measurements are divided into five categories of the animal’s environment: 1) the possibility of movement, 2) social contact, 3) floor conditions, 4) climate and 5) stockman care. Every measurement gets a score, and an overall TGI-index is calculated by summing up all the score values for the five categories assessed. The higher TGI-index you get, the better housing condition in terms of animal welfare. A certain minimum requirement shall be fulfilled within the different categories, but the different housing conditions can compensate each other. TGI200 is another version of TGI35L (Sundrum et al., 1994), allowing comparison between different farms and gives decision support for farmers and advisors on how to improve animal welfare at herd level (Sundrum, 1997). The TGI assessment systems have been
criticised for being risk assessments and not assessing the actual welfare state of the animals and for adding the different scores into a single welfare score (Capdeville and Veissier, 2001). The benefit of using resource-based measurements in the assessment system is that these measurements are relatively easy and quick to record with high repeatability (Sundrum, 1997).

The Bristol Welfare Assurance Program (BWAP) is an example of an on-farm welfare assessment system based only on animal-based welfare measurements (Main et al., 2004). BWAP is based on the logic of the “Five Freedoms and provisions” (FAWC, 2013) and was initiated to be a tool to audit the welfare on farms complying with standards of the Royal Society for the Prevention of Cruelty to Animal (RSPCA) ‘Freedom Food’ system (Webster et al., 2004). The BWAP was based on the consensus of expert opinions on welfare concerns using the ‘Delphi’ review process (Whay et al., 2003). Benefits of the BWAP are that the protocols are based on welfare outcomes and can identify specific welfare problems as they occur, and the system builds on a consensus among experts regarding importance of specific problems. A challenge with the system and with other systems with animal-based measurements is that specialists are often needed for conducting the assessment, and the system is often time consuming (Sundrum, 1997; de Vries et al., 2013).

Welfare Quality® assessment schemes for cattle (Welfare Quality, 2009a), poultry (Welfare Quality, 2009b) and pigs (Welfare Quality, 2009c) are based on both animal-based and resource-based measurements, with resource-based measurements mainly as a supplement when there are no valid animal-based measurements available (e.g. welfare risks which are difficult to measure all year around, like access to pasture and water provision) (Veissier et al., 2011). Welfare Quality® was a comprehensive EU project with participants from 17 countries with both social and animal scientists involved to have a multidisciplinary approach (Blokhuis et al., 2010; Blokhuis et al., 2013). The project developed a standardised system for assessing animal welfare, based on four welfare principles and 12 criteria that combined various scientific perspectives on how to approach farm animal welfare (see Table 1, Paper I and II). The criteria builds on the “Five Freedoms” as further described in chapter 2.3. How to measure the different aspects of welfare and how to combine the different results were discussed with citizen and farmer juries in different EU countries and on stakeholder conferences (Miele et al., 2011). The 12 criteria were defined to cover all dimensions of animal welfare with no redundancies between criteria and should be interpreted independently of each other. The different measures had to be valid (to actually say something about the animals’ welfare), feasible (suitable for on-farm assessment) and tested for inter-(between observers) and intra-observer (within the same observer) reliability and robustness to external factors. The results of the assessment are presented as scores per measurement, criteria and
principles and an overall classification into “Excellent”, “Enhanced”, “Acceptable” or “Not classified”. The different scores are aggregated in a way that scores within the same criteria or principle do not compensate each other (further explanation in chapter 3.3).

The existing Welfare Quality® protocols are comprehensive, and the assessment is relatively time consuming. Recent works have been looking for methods to reduce the timeframe for an on-farm assessment of animal welfare by reducing the number of animal-based parameters (Sundrum, 1997; de Vries et al., 2013; Andreasen et al., 2014) or/and looking for automatic measures, for example for lameness (Pluym et al., 2013; Schlageter-Tello et al., 2014) and by finding “iceberg indicators” that can reveal major welfare problems (Heath et al., 2014). Miele et al. (2011) found that compared with animal scientists, public seem to focus on animals’ experiencing positive emotions, while the scientists primarily focused on the animals’ absence of suffering. AWIN is a global network funded by EU-FP7 (2012-2015) looking at development, integration and dissemination of animal-based welfare measurements, including measurements of pain (AWIN, 2015). Although a high focus among scientists on the animals’ absence of suffering, there are several efforts on assessing positive welfare as described by Edgar et al. (2013).

There are some welfare assessment systems developed or under development for other synchronized production systems than mink, like for goat (Muri et al., 2013), sheep production (Stubsojen et al., 2011; Beltrán De Heredia et al., 2014; Koene and De Jong, 2014; Mialon et al., 2014) and beef production (Kirchner et al., 2014a). These systems mainly use animal-based welfare measurements and are based on the Five Freedoms and protocols established in Welfare Quality®. They all include only one visit to the farm. Muri et al. (2013) did not discuss which period would be best to assess, but Stubsojen et al. (2011) chose the lambing season due to enhanced risk of contagious diseases and other welfare-related problems. Beltrán De Heredia et al. (2014) and the AWIN project (AWIN, 2015) are working with welfare assessment in a two-step methodology to assess the animals’ welfare, with an objective screening of a farm in stage 1 according to welfare issues, and a more detailed second stage if welfare concerns are detected. By using the welfare measurement protocol developed by the AWIN project, Dwyer et al. (2014) found that the sheep welfare changes due to seasonal variation, and sheep’s reproduction stage and ewes in mid and late lactation were in poorer health than at other times. Kirchner et al. (2014b) also found changes in welfare with repeated assessment of beef bulls over six months, and claim that animal welfare classification in general should be based on repeated assessments in systems for certification purposes.
The two welfare assessment systems reported within mink production are the ones developed for management and advisory purposes, developed and tested in Denmark during 1998 to 2002 (Møller et al., 2003) and WelFur-Mink, developed for both certification of farms and secondary for advisory purpose (Mononen et al., 2012). The assessment system for management and advisory purposes was built on knowledge developed in Welfare Quality® with focus on animal-based parameters. In non-synchronous production systems, the same processes occur continuously throughout the year. Assessment of animal welfare is, therefore, not dependent on time of the year, except for some effects of season (e.g. animals on pasture). The seasonal production does, however, make it difficult to focus only on animal-based measurements if the aim is to intervene and improve the animals’ welfare (Møller et al., 2003). Animal-based measurements give information about the welfare status, but due to a short seasonal production period, the stockman might not be able to take action in time to improve the welfare before the whole group of animals are exposed. The advisory system was based on measurements from four sources: the system, the system’s management, animal behaviour and animal health (Rousing et al., 2001). The results were presented in a report for the farmer, with a general summary of the farm welfare and a summary of the welfare concerning each of the four sources, based on the results per measurement. The detailed results per measurement were compared with results from other farms.

The assessment system Welfur-Mink is based on the four welfare principles and 12 welfare criteria developed in the EU project Welfare Quality® (Blokhuis et al., 2010) (Table 1 in Paper I). The time window for assessment is the last 6-8 weeks of each phase, e.g. conditioning of breeders in January-February (assessment period 1), lactation and weaning in May-July (assessment period 2) and moulting and priming of the winter pelt in October-November (assessment period 3). The measures assessed on the farm are given a score, and the values are aggregated into 12 criteria scores and four principle scores, taking all the three production phases into account. The overall classification is based on the values of the four principle scores. WelFur-Mink is further explained in chapter 3.2 and 3.3.

2.3 Different welfare definitions

The measurements included in welfare assessment systems and the outlines of the systems are dependent on the definition of the welfare behind. There are many different understandings and definitions of the term animal welfare, all referring to the animals’ quality of life. Fraser et al. (1997) grouped the different understandings and definitions in three main approaches; 1: the
subjective experience approach, 2: the biological functioning approach and 3: the “natural living” approach.

1: The subjective experience approach focuses on the animals’ feelings. Feelings such as the animals’ pleasure, pain or suffering are important when evaluating the animals’ welfare. A reduction in the animals’ experience of negative feelings like pain and suffering and promotion of positive feelings like comfort and pleasure are increasing the animals’ welfare. Understanding the animals’ feelings or “affective state” is therefore the main task in defining animal welfare within this approach (Duncan, 1996).

2: The biological functioning approach focuses on the animals’ capability to cope with its environment, looking at the basic biological functions like good health and production (Broom, 1996).

3: The “natural living” approach focuses on the animals’ possibility of expressing its “natural behaviour” and living a “natural” life according to its genetically encoded nature or “telos” (Rollin, 1993; Harfeld, 2013). There are several definitions of natural behaviour based on discussions regarding what is natural for domestic animals (Keeling et al., 2011). Natural behaviour can be defined as the animals’ species specific behaviour, genetically encoded by evolution to adapt to its environment. Bracke and Hopster (2006) define natural behaviour as behaviour which animals have a tendency to perform under natural conditions because these types of behaviour are pleasurable and because they promote biological functioning.

Figure 3: Three approaches to animal welfare (Revised from Lund (2002)) as pointed out by Fraser et al. (1997). Each circle represents one of the three different approaches to animal welfare: the natural living approach, the biological functioning approach and the subjective experience approach. The three approaches do overlap, and the numbers in the circles indicate situations that can be considered acceptable by the particular approaches to animal welfare.
Table 1: The “Five Freedoms” defined by the Farm Animal Welfare Council (FAWC, 2013)

| Freedom from Hunger and Thirst | by ready access to fresh water and a diet to maintain full health and vigour. |
| Freedom from Discomfort | by providing an appropriate environment including shelter and a comfortable resting area. |
| Freedom from Pain, Injury or Disease | by prevention or rapid diagnosis and treatment. |
| Freedom to Express Normal Behaviour | by providing sufficient space, proper facilities and company of the animal’s own kind. |
| Freedom from Fear and Distress | by ensuring conditions and treatment which avoid mental suffering. |

The different approaches do overlap to some degree (Lund, 2002) (Figure 3), and Fraser et al. (1997) emphasized that the different approaches should be taken into account in animal welfare science without adopting a particular concept to the exclusion of others. “The Five Freedoms”, published by the Farm Animal Welfare Council (FAWC) (FAWC, 2013), do combine the three approaches (Table 1). As an introduction to the “Five Freedoms”, FAWC writes that “The welfare of an animal includes its physical and mental state and we consider that good animal welfare implies both fitness and a sense of well-being”. They further write that the “Five Freedoms” define an ideal state of welfare rather than standards for acceptable welfare. The first and third freedoms mainly refer to good biological functioning of the animal. The fourth freedom refers to natural living and the second and fifth freedom refers to animals’ emotional state and subjective feelings. In this way, the five freedoms’ approach involves all three main elements in the discussion of how to define animal welfare. The five freedoms are, however, not very precise in defining animal welfare, using words like “appropriate environment” and “sufficient behaviour”. Another problem with including all three approaches in a definition of welfare is that there might be conflicts between meeting the different preconditions for good welfare and a need for trade-off between the different threats and opportunities (Keeling et al., 2011).

2.4 WelFur’s approach to animal welfare

The principles of welfare in Welfare Quality® and the assessment system WelFur are derived from the “Five Freedoms”. Looking at the four principles of welfare developed in Welfare Quality® (Table 1, Paper I), the principle of “Good feeding” and the principles of “Good health” are mainly dealing with the freedoms referring to “good biological functioning”. It is about water, food and health. The principle of “Good housing” and the principle of “Appropriate behaviour” include both the freedom to express normal behaviour and freedom from fear and distress. In that way, Welfare
Quality® has combined the three approaches to animal welfare in the assessment system. Veissier et al. (2011) claim that: “any system of welfare assessment will be based on choices which reflect values, including values related to animal ethics”. Therefore, it is important to make the choices transparent.

The four principles and 12 criteria of welfare in Welfare Quality® were developed based on discussion with different stakeholders, both animal scientists, social scientists, an advisory committee (of representatives of farmers, breeders, retailers, veterinarians, animal protectors and from EU Commission and OIE) and consumer-citizen group across different countries. The citizen group highlighted the importance of providing natural environment for the animals (Miele et al., 2011), while the scientists had their main focus on the animals’ mental state, evaluated by looking at the strength of animals’ preferences (Veissier et al., 2011). In Welfare Quality®, animal welfare was therefore mostly considered a matter of how the animals perceive the environment. To meet the consumers’ concern about animal welfare, resource-based measurements to measure welfare situations that are difficult to measure with animal-based measures, like outdoor access, amount of space available and measurements related to expression of natural behaviour, were included (Miele et al., 2011). Regarding freedom to express normal behaviour, there are several parameters included in the WelFur assessment to evaluate this, like opportunity to use enrichment and ability to nest building. Other types of natural behaviour like natural light conditions governing the natural annual life cycle, natural mating and nursing of their own kits are a natural part of the mink production and therefore not included in the WelFur assessment.

2.5 Animal health and welfare planning

Improving health and welfare of farm animals is dependent on implementation of knowledge into practice by the farmer. Several studies have shown that assessment of welfare with reliable and feasible assessment systems does not necessarily lead to intervention and welfare improvements on farms (Valeeva et al., 2007; Whay, 2007; Whay and Main, 2010). One reason might be that the information produced is presented in a way that does not correspond to the way the farmers’ work is carried out in practice. One way to handle this is the development of assessment systems in close dialogue and collaboration with the end users (Jorgensen et al., 2007; Pompe and Hopster, 2014). Animal health and welfare planning as a continuous process is found to be a promising method for obtaining on farm welfare improvements (Tremetsberger and Winckler, 2015). Animal health and welfare planning consist of animals’ health and welfare assessment, identification of risk factors,
development and implementation of interventions and a constant review and adaption of the welfare situation. The key issue in welfare planning is the continuous process of on-farm improvement of the animals’ welfare. Health and welfare plans are part of different UK farm assurance schemes and have shown to be useful for identification of farm-specific solution for farm-specific problems (Nicholas and Jasinska, 2008). Many plans have apparently been too large and too complicated to follow and they have rarely been reviewed (Atkinson and Neale, 2008; Nicholas and Jasinska, 2008). The EU CORE Organic funded project entitled “Minimising medicine use in organic dairy herds through animal health and welfare planning (ANIPLAN)” (2007-2011) defined a set of criteria for animal health and welfare planning (Nicholas et al., 2008; Vaarst et al., 2011) (Table 2). Farmer ownership, where the farmer identifies his/her own targets, is found to be crucial for implementation of animal health plans (Vaarst et al., 2011) and is one important criteria.

The different criteria for welfare assessment can be implemented in different ways, for example through dialogue between farmer and advisor (e.g. ProQ in Switzerland (Ivemeyer et al., 2008)), and through stable schools’ (Vaarst et al., 2007). The information and methods required to help the farmers in making their decisions might differ, dependent on the farmers’ personality (Jorgensen et al., 2007). Stable schools have been tested as a way of utilising the knowledge and experiences among mink farmers to improve the animal welfare on their farm and will be further explained in the next chapter (2.6). The groups were introduced to WelFur results of their farms as general information into the group.

Table 2: Principles of animal health and welfare planning (Nicholas et al., 2008)

<table>
<thead>
<tr>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous development and improvement (welfare assessment, evaluation, action, review)</td>
</tr>
<tr>
<td>Farm-specific</td>
</tr>
<tr>
<td>Farmer ownership</td>
</tr>
<tr>
<td>External person(s) should be involved</td>
</tr>
<tr>
<td>External knowledge</td>
</tr>
<tr>
<td>Organic principles framework (systems approach)</td>
</tr>
<tr>
<td>Written</td>
</tr>
<tr>
<td>Acknowledge good aspects</td>
</tr>
</tbody>
</table>
2.6 Stable schools

Jørgensen et al. (2007) found that new knowledge needs to be presented in line with the way farmers carry out their work in order to reach the farmer and change farm practices. Discussions among farmers are, therefore, likely to be a useful way to increase the level of common knowledge and lead to improvement of animal welfare on farms. Respected farming colleagues have especially been found to be important for on-farm changes, discussing real-life solutions and practicalities for potential changes (Hockenhull et al., 2014). Different discussion groups where farmers meet with an advisor are common in many countries. In Denmark, such groups are called “erfa-groups” (‘erfa’ stands for the Danish word ‘erfaring’, which means experience).

A stable school is a special kind of discussion group, where knowledge is exchanged between farmers working towards a common aim, giving practical farm-specific advice to each other related to the common aim (Vaarst et al., 2007). In stable schools, one farm is the host for and in focus at each meeting. The concept is based on a common learning process, and the principle of situated learning (Lave and Wenger, 1991) originates from Farmer Field Schools (FFS), developed and used in developing countries (Gallagher et al., 2006; Vaarst, 2007). Situated learning is a learning process that first of all takes place in the same context in which it is applied, embedded in a social, cultural and personal context (Lave and Wenger, 1991). One principle of FFS is that only the learner him/herself can discover and describe what is relevant and meaningful (Vaarst et al., 2007). The stable school implements this by letting the members of a stable school decide what they want to focus on in their own farm, and the common learning and experiences in the group are built on this. Another principle is that “Learning is a consequence of experience”, which in the stable schools is built up by sharing experiences between participants in the group, sharing insights and learning from experiences of initiations of new routines and improvements on their farm (Vaarst et al., 2007). Free and open communication and confrontation are also important principles for FFS, with all having equal rights to contribute. In stable schools, there are therefore no external expert involved, but a facilitator leading the process and discussion. All the participants are in the same situation and shall have the same opportunity to tell about experiences, give opinions and be able to contribute.

Stable schools have shown to be appreciated by farmers and useful in improving animal health in dairy production (Vaarst et al., 2007; Ivemeyer et al., 2012; March et al., 2014). Ivemeyer et al. (2014) give an overview of several on-going and completed research and advisory activities using stable schools for dairy herd health and welfare improvement in several European countries and
show that there has been activity in seven countries (Austria, Switzerland, Germany, Denmark, Netherland, Norway and UK). There are also some positive experiences with stable schools in sheep and pig production (Hektoen and Sogstad, 2011; Studnitz, 2014). Many of the improvements implemented on farms as a result of stable schools in the different studies were typically changes in management routines in a way that was useful for the specific farmer and in line with the farmers’ priorities, as especially mentioned by Bennedsgaard et al. (2010). Mink farmers are used to look for local solutions to make improvements in their production, due to a production where all the steps from birth to pelting often take place within the same farm. The farmers’ skills need to be diverse, and many farmers have a great knowledge and experience in different practical solutions to different problems. Stable schools utilizing the knowledge and experiences among mink farmers to get farm-specific and practical advices and solutions might therefore be a useful tool to induce changes in management to improve mink welfare. The seasonality of mink production gives the farmers ample time to do changes and improvements related to the different periods. On the other hand, this might be a challenge in stable schools where the actual problems discussed might not be present until many months later (Møller et al., 2003; Møller and Sørensen, 2004).
3 Materials and methods – an overview

The PhD study consists of two main technical parts. The first part is focusing on procedures, based on the WelFur-Mink assessment system, to evaluate welfare in a strictly synchronized production system. The second part is focusing on the use of stable schools as a tool to improve animal welfare on mink farms.

3.1 On-farm research

The general method in the PhD study is on-farm research. On-farm research can be defined as research carried out on farmers’ production units and in a farmer's environment (Sørensen and Hindhede, 1997). The aim of on-farm research is typically to develop or evaluate new technology and tools for farmers. The farmer is more or less involved in the research, depending on the objective of the on-farm research and the nature of the research in terms of components, systems or technologies being assessed. To develop procedures for welfare assessments that are relevant for different farms, assessments on more than one farm within the different production phases were necessary. The procedures should work in practice and be relevant for mink farmers and assessors. Therefore, the study was conducted on private mink farms in addition to Aarhus University’s research farm at AU-Foulum.

3.2 The assessment method WelFur-Mink

WelFur-Mink was chosen as the starting point for assessing mink welfare and the procedure to be optimised according to assessment in a strictly synchronized production system. It was the only assessment system developed for an evaluation of animal welfare in all phases of a seasonal production (see chapter 2.2.). In addition, WelFur-Mink was the newest and most comprehensive assessment system developed for assessment of animal welfare in mink production. WelFur-Mink includes both animal-based and resource-based measurements which is in line with Welfare Quality®, which uses resource-based measurements if it is practical impossible to use an animal-based measure (Blokhuis et al., 2010; Mononen et al., 2012). Animal-based measurements will reveal welfare problems when the animals actually are experiencing the problem. In a strictly seasonal synchronous production system, all the animals might be at risk of a welfare problem at the same time. Resource based measurements can indicate the risk of a welfare problem before the animals experience any problems. Resource-based measurements are, therefore, important in an
assessment system for decision support in a strictly synchronous production system in order to be able to prevent the development of potential welfare problems (Møller et al., 2003).

Welfur is based on the criteria and principles of welfare developed in Welfare Quality® (Botreau et al., 2007; Blokhuis et al., 2010) as described in Paper I and II (Material and methods). In the process of developing the Welfur protocol, many parameters for assessing animal welfare were evaluated in terms of validity (does the measure reflect the specific aspect of the actual welfare of animals), reliability (acceptable inter- or intra-observer repeatability and robustness to external factors, e.g. time of day or weather conditions) and feasibility (is it possible to measure at one day visit). Welfur-Mink protocol ended up with 22 measurements assessed in the three assessment periods related to the different phases of mink production. An overview of the measurements is shown in Appendix 1. The evaluation of the different sub-measures assessed on the farm goes into a score on a scale from 0 (worst) to 100 (best). Calculations of the different scores are based on expert opinions of the different welfare situations measured (Mononen et al., 2012).

3.3 Aggregation and estimation of Welfur scores (Paper I and Paper II)

The calculations of the different scores per criteria and principles were not finalised when this PhD study was initiated. The different Welfur scores were necessary for testing hypothesis one and two, and calculation of scores per period had to be developed for testing hypothesis two. Therefore, I developed calculations of the full annual Welfur scores, based on instructions in the Welfur-Mink protocol, using the spreadsheet Excel (Microsoft Office 2010) and the statistical software R (R Core Team, 2014). Different errors in the calculations described in the first version of the printed protocol were revealed and corrected before calculation of scores per period could be developed.

The Welfur assessment system uses different methods to compute data from measurements into criterion scores. One method is the decision tree, which is used when all measurements are measured at farm level with a limited number of categories or when there are more than four possible situations at animal level. Another method is calculation of the proportion of animal in the different situations of a measurement taken at individual level. A weighted sum is calculated for the different situations with weights increasing with the severity of a problem. The weights are defined to give the same ranking of farms as the one given by experts from animal sciences, and l-spline functions were used to produce the criterion score. This is when the criterion is assessed based on only one measurement taken at individual level. To calculate a criterion score composed of different measurements or of measurements assessed at several observation periods or on several animal
types (e.g. adults vs. juveniles), the different levels were aggregated using Choquet integrals (Grabisch, 1996). The Choquet integral calculates the difference between minimum scores and the next minimum score and assigns a weight (capacity) to this difference according to which period (or animal types or measures) that is concerned. The capacity is determined by using a linear optimisation in order to best match the answers of the experts. The experts focused on worst scores with lower scores at criterion level than the average of the sub-scores obtained at period level that goes into the criterion. The Choquet integral is limiting the possibility of compensation of low scores on some periods or criteria by high scores on others. Choquet integral and capacities for the different criteria were also used for calculation of the principles.

Estimation of score values per period was made by excluding the step of weighing the score values between periods (using the capacities). The capacity of each period within the single measurement or criterion is set because the experts found some periods to be more important than others, due to duration of the period and the type and number of animals present on the farm during each period. This is not relevant when looking at the single scores at the different periods separately, and the calculations were made only by score values and weights within periods.

### 3.4 Selection of farms

There were two groups of farmers involved in the PhD study. One group consisted of nine farms from the assessment of WelFur in 2011 including Aarhus University’s research farm at AU Foulum. Three of these farms, plus the research farm, were included in testing hypothesis I (Paper I). The nine farms, in addition to ten new farms selected especially for the PhD study (second group), were included in the study testing hypothesis II (Paper II). The ten new farms were also involved in testing the research question about stable schools in the qualitative study (Paper III). The ten farms were chosen from two veterinary districts, with five farms in each district. Five to six farms per stable school is recommended (Lisborg et al., 2005), and five farms in each of two districts were chosen due to forming two stable schools. It was chosen to include farms from two different districts in order to get different local inputs to the group and potentially different views and experiences on different aspects of management practices and animal welfare. Around five farms is found to be an ideal number of farms to get a good discussion in a stable school (Vaarst et al., 2007). The farms could vary in farm size but should all have some animals in group housing. This to increase the possibility of having farms with welfare problems due to research showing a higher risk of bite wounds in groups of four mink in the same cage (Hansen et al., 2014). Reasons for
wanting farms with potential welfare problems were to get variation in data both within and between farms and to have farms in stable schools that were motivated for working with and improving their animals’ welfare. The ten farms were asked to join both the study of WelFur assessment in the three production phases and a stable school. The farms from 2011 (group 1) were included to increase sample size and to get data from another year, independent from stable schools. Table 3 shows an overview of which studies the different farms were involved in.

The ten farms involved in both the study testing hypothesis II (WelFur in three assessment periods) and the study testing hypothesis III (Stable schools in mink production) were initially visited in the assessment period 3 in 2012 to practice the assessment procedure and to get data from the farms before starting the studies with stable schools and providing the farmers with information of the animal welfare on the farms. The procedure of the assessment of injuries (the scoring of healed injuries), fur chewing (moderate fur chewing) and temperament (fearful animals) in assessment period 3 in 2012 differed from the procedure of assessments in the different periods in 2013. Therefore, no WelFur scores on criteria or principle level for these data are calculated, and they were not included in the studies. Information about injuries (the amount of animals with any kind of injury) and mortality of animals in assessment period 3 in 2012 and 2013 is shown in Appendix 2.

3.5 Stable school (Paper III)

Stable schools were used as a potential method to utilise the knowledge and experiences among farmers to improve animal welfare in a strictly synchronized production system. Other alternative methods are discussion groups as discussed in Paper I.

The main principles of a stable school are:

- Common goal or aim
- Farmer’s ownership of the process
- Equality, all being experts and should contribute
- Facilitator leading the process
- Written minutes from the meetings
- Distribution of roles

A stable school consists of farmers from five to six farms. They are working towards a common goal or aim and can be diverse with different farm size, experiences, housing condition etc. to get
variation in perspectives and experiences in the group. The common goal/aim can be met in many different ways, and every participant choses two problem areas he/she wants to work with, relevant for the common goal, and one success story to tell the others. The farmers meet twice per farm within one year. At the second meeting, the success story is replaced with a follow-up on the initiatives started at the first meeting. The facilitator shall help the farmer with identifying topics that he/she wants to work with and send invitation and information to the other group members.

Table 3. An overview of which studies the different farms were involved in. The farms are identified by the number of female mink on the farm in assessment period 2.

<table>
<thead>
<tr>
<th>Females per farm (period 2)</th>
<th>Study I</th>
<th>Study II</th>
<th>Study III</th>
</tr>
</thead>
<tbody>
<tr>
<td>2670</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>3400</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>x</td>
<td>x</td>
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<td>x</td>
<td></td>
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<tr>
<td>4300</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
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<td>x</td>
<td></td>
<td>x</td>
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<tr>
<td>2240²</td>
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</tr>
</tbody>
</table>

¹ The experimental farm AU-Foulum
² Mean number of females per mink farm in Denmark (Clausen, 2014)
However, the facilitator can by advantage be familiar with the relevant farming practice to be able to help the farmer finding what to work with and leading the group discussions. At the meetings, the facilitator shall direct and facilitate the discussion, keep the agenda and write minutes. The minutes must contain the conclusions from the meetings and which initiatives the host farmer wants to induce.

3.6 **Qualitative interviews (Paper III)**

The stable schools were a one year process, but potential changes induced at the school meetings might be implemented the year after due to the seasonality of the production. A comparison of changes in management or welfare before and at the end of the year with stable schools will therefore have minor utility. One of the objectives of the present thesis was therefore to explore the farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare. Different methods could have been used to explore the farmers’ perception, and three possibilities were discussed: Qualitative interviews, quantitative interviews and questionnaires.

Qualitative interviews are often used to get a picture of different aspects of the interviewee’s life, and attempt to understand the world from their points of view (Kvale and Brinkmann, 2009) (p.1 and p.30). Qualitative interviews give the possibility to explore the respondents experience, expectations and opinions and can give the history behind the respondents’ different answers by asking follow-up questions. Qualitative interviews do not aim at quantification but give qualitative knowledge expressed in normal language (Blackstone, 2014). Alternatives to qualitative interviews could be quantitative interviews or questionnaires with answer options to the respondents. The quantitative methods aim to represent and condense data into numbers and can be easier to analyse than qualitative interviews. One advantage with questionnaires compared with interviews is consistency. There is no interviewer affecting the process by the way the questions are asked or answer options presented or explained. Questionnaires can also reach a larger sample at a much lower cost than interviews. On the other hand, advantages with interviews are a higher response rate and lower respondent confusion. It might be easier to say no to an e-mail or letter than to a person wanting to ask you some questions, and in an interview, the respondents can ask the interviewer to explain questions or answers of which they do not understand the meaning.

The farmers are the end-users of the stable school system and involving end-user groups in evaluation of relevant advisory tools by using qualitative interviews has shown to be useful (Vaarst,
Qualitative interviews also give an opportunity to explore issues that the farmers bring up along the way, which can be important and relevant for the farmer, but not thought of by the interviewer. Qualitative interviews were therefore used in the study, and the study was designed as a semi-structured qualitative interview using the phenomenological approach as described in Kvale and Brinkmann (2009). In qualitative studies, you normally do not work with hypothesis but make an interview guide based on a research question you want to answer. The semi-structured interview is based on an interview guide with topics to be covered and suggested questions (see Appendix 3). This is to be sure to discuss topics that are relevant for the research question. Therefore, hypothesis III for the thesis was converted to a research question for Paper III.
4 Results

The results of the thesis are presented as three papers investigating the three hypotheses of this PhD thesis:

Hypothesis I (Paper I)

In the nursing period, the prevalence of four animal-based measures changes so much with the date of the assessment, that it influences the WelFur scores at criteria level, but not at higher levels.

Hypothesis II (Paper II)

The overall annual welfare classification of a mink farm in the welfare assessment system, WelFur, can be based on assessments in only one of the three annual production phases.

Hypothesis III (Paper III)

It is possible, based on qualitative interviews, to explore how farmers perceive stable schools as a tool to improve farm management for the benefit of mink welfare.

With the research question: How do farmers perceive stable schools as a tool to improve management for the benefit of mink welfare?
4.1 Paper I

The reliability of welfare assessment according to the WelFur-protocol in the nursing period of mink (Neovison vison) is challenged by increasing welfare problems prior to weaning

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Published in Animal Welfare 2015, 24: 193-201
Included in the thesis with permission from the journal’s editorial board
The reliability of welfare assessment according to the WelFur-protocol in the nursing period of mink (Neovison vison) is challenged by increasing welfare problems prior to weaning

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Abstract

The objective of this study was to test the hypothesis that the body condition of the mink dam, the frequency of dirty nests, frequency of injuries and diarrhoea change significantly with the day of assessment, post-partum, within the data collection period from parturition to weaning, influencing the scores of WelFur at criteria level, but not at principal level or the overall category of mink (Neovison vison) welfare according to the WelFur-Mink protocol. Data from a representative sample of around 120 dams and litterers on four farms were collected three to four times in the period stipulated by the WelFur-Mink protocol. WelFur-scores between 0 (worst) and 100 (best) were calculated, aggregated and compared at criteria and principal level. The score for the criterion ‘Absence of prolonged hunger’ dropped from 86 to 38 after about five weeks of lactation, affecting the principal score ‘Good feeding’, but not by enough to affect the estimated welfare classification. The score for the three other measures also varied with date of assessment but not enough to affect the classification. However, the observed change in the four measures we focused on indicates that a change in the overall WelFur classification can occur if these or other measures change a little more for the better or worse. Possible solutions to this could be reducing the time window for assessment, development of a valid correction factor or to stratify the visits into an early, middle and late visit on a farm within the three registration periods.

Keywords: animal welfare, body condition score, diarrhoea, housing, injuries, mink production

Introduction

WelFur is an on-farm welfare assessment system for foxes (Vulpes) and mink (Neovison vison) based on the principles developed in Welfare Quality® (Moenen et al 2012). Welfare Quality® has set up 12 criteria, covering four principles for good animal welfare (Table 1). The protocol for mink is based on 22 measures taken on breeders, during lactation and in late growth in order to cover all phases of production. Mink are strictly seasonal and these phases of production take place therefore in three different periods of the year. The measures are aggregated into scores across the three production periods, then for 12 criteria, four principles and an overall classification per farm (Botreau et al 2012).

Due to the seasonal production, all kits are born within few weeks of each other in late April/early May (Møller et al 2003). Therefore, the time window for assessment of welfare during the nursing period (period 2) is limited to approximately seven weeks from parturition to weaning, and the date of assessment is highly correlated with age of the kits. Mink kits grow from 10-11 g at birth to 520-655 g at weaning after about eight weeks (Hansen 1997). This requires a very high milk yield from the dam and a successful transition of the kits to solid food and to the drinking water system. Lack of success in this critical and demanding period, with great changes both for the mother and the kits, increases the risks of health problems and aggression between the mink (Møller 1993; Brink & Jeppesen 2005). Therefore, we expect a number of potential welfare problems in this period to be age-dependent, potentially implying a dependency on the date of assessment of welfare of both the dam and the kits. The data collection period in WelFur-Mink in the reproduction period is between May 5th and July 1st, or to when weaning begins. When WelFur-Mink is applied in practice, such an age-dependency, due to changes in management and biology of the mink during lactation, is a challenge to the reliability of the welfare assessment. The dependency of the date of assessment is mainly expected within the following four welfare criteria.

Absence of prolonged hunger

Due to the high milk production, the dam loses bodyweight during the lactation period. That is especially pronounced after four weeks of lactation, when the dam reaches an upper limit for food consumption and starts mobilising body reserves to produce milk for her kits (Hansen 1999), increasing the risks of very thin dams.
Results: Paper I

Table 1 The WelFur principles of welfare, with the underlying criteria and measurements.

<table>
<thead>
<tr>
<th>Principle</th>
<th>Criterion</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Good feeding</td>
<td>1 Absence of prolonged hunger</td>
<td>Body condition score</td>
</tr>
<tr>
<td>2 Absence of prolonged thirst</td>
<td>Continuous water availability; measured by: Type of watering system; Functioning and cleanliness of the water points</td>
<td></td>
</tr>
<tr>
<td>2 Good housing</td>
<td>3 Comfort around resting</td>
<td>Access to a nest-box, Resting quality of the nest-box/RESTING area</td>
</tr>
<tr>
<td>4 Thermal comfort</td>
<td>Protection from exceptional weather conditions, Nest-box material and bedding/nesting material</td>
<td></td>
</tr>
<tr>
<td>5 Ease of movement</td>
<td>Space available for moving (area and height)</td>
<td></td>
</tr>
<tr>
<td>3 Good health</td>
<td>6 Absence of injuries</td>
<td>Skin lesions or injuries to the body</td>
</tr>
<tr>
<td>7 Absence of disease</td>
<td>Mortality, Diarrhoea, Lameness or impaired movement, Obviously sick animals</td>
<td></td>
</tr>
<tr>
<td>8 Absence of pain induced by management procedures</td>
<td>Killing methods for pelting of mink; Killing methods for individual mink</td>
<td></td>
</tr>
<tr>
<td>4 Appropriate behaviour</td>
<td>9 Expression of social behaviours</td>
<td>Social housing in the growth period (period 3), Age and procedures at weaning in the summer period (period 2)</td>
</tr>
<tr>
<td>10 Expression of other behaviours</td>
<td>Stereotypic behaviour, Cage enrichments, Fur chewing</td>
<td></td>
</tr>
<tr>
<td>11 Good human-animal relationship &amp; 12 Positive emotional state</td>
<td>Frequency and duration of handling and transportation, Temperament test</td>
<td></td>
</tr>
</tbody>
</table>

* The two criteria are based on the same measurements.

Comfort around resting
To ease the kits’ access to food they are fed on the lid of the nest box from around four weeks of age, increasing the risk of dirty nests and decreased resting quality of the nest box.

Absence of injuries
The kits are dependent on the mother’s milk until they start to drink water at about six weeks of age (Moller & Lohi 1989; Brink & Jeppesen 2005). The kits’ need for water increases, and just before they start drinking from the watering system, the risk of saliva licking from the dam’s mouth, aggression and injuries among the kits increase (Moller & Lohi 1989; Brink & Jeppesen 2005; Clausen & Larsen 2012). Danish mink housing systems provide water from a nipple at the end of the cage, opposite the nest. Additional water for the kits has been shown to advance water intake and reduce saliva licking (Moller & Lohi 1989; Brink & Jeppesen 2005). Therefore, some farmers install some kind of additional water supply during this period in addition to saturating the feed with water.

Absence of disease
The kits are at risk of ‘sticky kits’ (ie diarrhoea and excessive secretion from the cervical apocrine glands caused by astrovirus) (Clausen & Dietz 2000; Englund et al 2002), before they start to eat solid feed around four weeks of age. After this age, the risk of ‘normal’ diarrhoea caused by E. coli bacteria increases.

The objective of this study was to examine changes during lactation (measured as the average kit’s age) in:
- The mink dam body condition score — a change is expected after about four weeks of lactation due to mobilisation of body fat reserves;
- The prevalence of dirty nest-boxes — we expect it to change around four weeks of lactation, due to feeding on the nest-boxes from this age, to ease the kits’ access to food;
- The prevalence of injuries — we expect the frequency of injuries to increase, especially at five weeks of age, just before the kits start to drink water; and
- The prevalence of diarrhoea — the kits might get diarrhoea just after they start to eat solid food at about four weeks of age, and there is a risk of sticky kits before they start to eat.

The hypothesis is that the prevalence of very thin mink dams, of dirty nests, of injuries and of diarrhoea change significantly with the date of assessment within the data-collection period, influencing the scores of WelFur at the criteria level. We further expect, however, that the number and magnitude of changes will not be enough to change the welfare score at the principal level or the overall category of welfare according to the WelFur-Mink protocol.

Materials and methods
Target and study population
The target population was all mink on the approximately 1,450 production farms in Denmark in the nursing period from parturition to weaning of the kits. The study population was mink in the nursing period at four mink farms in Central Jutland. The study sample consisted of about 120 cages with one dam and her kits per farm per day of observation. A sample of 120 cages is found to be enough to get a representative sample of animals from a mink farm, independent of farm size (Rousig et al 2012). The study sample was taken in order to be representative regarding colour type of mink, primi- and multiparous dams and...
Results: Paper I

Table 2: Welfare classification of farms regarding welfare (revised from Mononen et al. 2012).

<table>
<thead>
<tr>
<th>Category</th>
<th>Required score values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best current practice</td>
<td>Score 55 on all four principles, and more than 80 on at least two</td>
</tr>
<tr>
<td>Good current practice</td>
<td>Score 20 on all four principles, and more than 55 on at least two</td>
</tr>
<tr>
<td>Acceptable current practice</td>
<td>Score 10 on all four principles, and more than 20 on at least three</td>
</tr>
<tr>
<td>Unacceptable current practice</td>
<td>If the minimum standard 'Acceptable current practice' is not met</td>
</tr>
</tbody>
</table>

housing conditions on the farm. The study unit was a cage with a dam and her kits.

In the summer of 2012, data were collected three to four times per farm, in the period from parturition to weaning, in accordance with the WelFur-Mink protocol. The average and median date of birth is April 30th and more than 95% of litters are born within ± 7 days (Møller, personal communication 2014). To evaluate the importance of which date we assessed the farms, the day of observation is therefore defined as average day, postpartum (pp), equal to date in May (ie with the mean day of birth set to April 30th). The first assessment was about one week post-partum, and the farms were assessed again every two weeks until they began weaning.

Description of variables

Four farms were included in the study. One farm was Aarhus University's research farm at Foulum, Denmark, the other three were private farms run under production conditions. Four experienced observers collected data from the four farms, while data were recorded by an assistant. One of the observers visited two farms and one farm was visited by two observers each collecting and recording data on half the farm. The same observers returned to the same farms for each visit during the nursing period, while the assistant sometimes differed. In total, 506 cages were observed, and the same cages were observed at each visit. A total of 1,554 cage observations were obtained of which 28 were after weaning; ie the dam was removed from the cage at the last visit. The total number of kits observed in the study on all four farms was 2,731 kits, with 44 kits fewer at the first visit and 78 kits fewer at the last visit. Not all kits in all litters were counted at the first visit, and some of the kits were moved (cross-fostering due to litter size) or euthanized due to disease, injuries etc at the last visit.

Missing data were treated in the following way: if information about the number of kits in the cage was missing, the minimum number of kits observed in the same cage in the previous or following visits was included. The WelFur protocol was still under development in 2012, and the final protocol was finished in 2013. The calculations are based on the final protocol. The temperament test was not included in the protocol in 2012, but was reintroduced in the final protocol, and data are therefore needed for the calculation of welfare scores. Mean values from the temperament test in the nursing period on nine mink farms in 2011 (hereafter called 2011-farms) were therefore included in the aggregation into WelFur-scores. Data from these nine farms were collected in another study in 2011 in connection to the WelFur project (Mononen et al. 2012). Three of the four project farms in the present study were among the nine 2011-farms.

The main mink colour type in the study population is brown (BRW). The research farm only had BRW in the study sample, while the other farms had different colour types.

Scoring and aggregation

In the WelFur-Mink assessment, a score is calculated for each welfare measure based on the registrations on each farm in each period. These scores are aggregated into scores across periods, then into 12 criteria scores and a score for the four principles (Botreau et al. 2012; Mononen et al. 2012). Table 1 gives an overview of the WelFur principles of welfare with the underlying criteria and measures. The scores at each level have values between 0 (worst) and 100 (best). The overall classification of a farm in WelFur is based on the same combination of the four principle scores in four categories as used in Welfare Quality®. In order to stress that the welfare assessment relates to the current farm animal production systems and views of animal welfare in the society, the terms are changed from 'Excellent', 'Enhanced', 'Acceptable' and 'Not classified' in Welfare Quality® to 'Best current practice', 'Good current practice', 'Acceptable current practice' and 'Unacceptable current practice' in WelFur. The score values required for classification into the different categories are shown in Table 2.

Each measurement in the WelFur protocol was scored at each assessment in order to investigate changes with age of the kits. The four measurements expected to change the most are 'Body Condition Score', 'Dirty nests', 'Injuries' and 'Diarrhoea including sticky kits'. These measurements are part of the criteria 'Absence of prolonged hunger' (Body condition score), 'Comfort around resting' (Dirty nests), 'Absence of injuries' (Injuries) and 'Absence of disease' (Diarrhoea including sticky kits). The score of other measurements from the nursing period, included in the respective criteria, was set to the average value of the assessments on the four farms. The WelFur protocol is based on aggregation across three periods, while our calculations are for one period only. We therefore used average values from WelFur-assessment on the nine 2011-farms for the other two periods (winter and autumn) to simulate how the measurements that
Table 3  Explanations of variables used in the statistical calculations.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days post-partum (pp)</td>
<td>Counted as days from April 30th (the mean day of birth) to the day of visit. There were visits on 12 days pp (3, 8, 9, 10, 22, 23, 24, 35, 36, 44, 51, and 52). In the statistical calculations the visits until 23 days pp (Figure 1[a]) up until 36 days pp (Figure 1[c]) were grouped into one category. This was done if there were no or very few observations of 'responses' (poor welfare outcome measures) in the respective days. (nominal variable)</td>
</tr>
<tr>
<td>Body condition score</td>
<td>BCS of the dam only, values too thin = 1, ok = 0. Dichotomous (binary variable). ‘Too thin’ means dams in BCS 1 on a scale from 1–5.</td>
</tr>
<tr>
<td>Dirty nests</td>
<td>Dirty nests got the value = 1, if ok, 0. Dichotomous (binary variable)</td>
</tr>
<tr>
<td>Injuries</td>
<td>If mink (kits or adult) with injury in the cage = 1, if not, 0. Dichotomous (binary variable). The injuries can be on a WelFur-scale from 1 (unhealed injuries with a diameter &lt; 10 mm or minor healed lesions, for example, missing less than half the tail), 2 (unhealed injuries with a diameter ≥ 10 mm and ≤ 30 mm, or major healed lesions, for example, missing more than half the tail) to 3 (unhealed injuries with a diameter &gt; 30 mm or major unhealed injuries, for example missing more than half the tail)</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>If observed diarrhoea or the disease sticky kits, value 1, if not, 0, Dichotomous (binary variable)</td>
</tr>
</tbody>
</table>

change with age of the kits contribute to the annual score per criterion, per principle and to the overall classification.

In order to evaluate if there are other measurements in the nursing period that influence a change at criteria and principal level, or a change in the overall classification with the age of the kits, we inserted the actual farm values for all measures in the aggregation at each visit in the lactation period of 2012. For missing values, data from the 2011-farms were inserted.

Statistical analysis

The following dichotomous outcome variables were studied: Body condition score (very thin = 1 or not = 0), dirty nests (present = 1 or not = 0), injuries (observed = 1 or not = 0) and diarrhoea (observed = 1 or not = 0). Table 3 gives an overview of the variables in the statistical analysis. The main interest was in characterising the probabilities of each of those outcomes in terms of kits’ age. This was done by using logistic binomial mixed models in which the dependent variables were each of the outcomes above and the kits’ age entered as a discrete explanatory variable. The models contained a random component representing the farm where the animals were raised, representing in this way a possible effect of farm and accounting for possible dependency of observations of animals raised on the same farm. The logistic binomial mixed models were adjusted using the package lme4 (Bates et al 2014) of the statistical software R (R Core Team 2014) and the P-values of the likelihood ratio tests were calculated using parametric bootstrap (Davidson & Hinkley 1997; Faraway 2006). A null hypothesis of a hypothesis test was rejected (and the correspondent effect was declared statistically significant) when the P-value of the test was less than 5%.

The Kruskal-Wallis test was used to evaluate a change in the calculated welfare score per criterion and per principle at around five weeks of lactation (mean age of the kits = 35 days).

Results

Descriptive results

In general, there was low prevalence of critical welfare observations across measurements. Observations of very thin animals (BCS = 1) were all after 23 days pp, and the last observation without very thin animals (all BCS = 0) were at 35 days pp (Figure 1[a]). Observations of dirty nests (‘Dirty nests’ = 1) and observations of injuries (‘Injuries’ = 1) were also mainly at the end of the lactation period, after 36 days pp (Figure 1[b] and [c]). Diarrhoea or sticky kits (‘Diarrhoea’ = 1) were mainly observed at farm 1 after the kits began to eat solid food around 28 days pp (Figure 1[d]).

Analytical results at measurement level

The prevalence of very thin animals increased significantly from 24 days pp (P < 0.001) (Figure 1[a]), and the prevalence of dirty nests increased significantly from 36 days pp (P < 0.005) (Figure 1[b]). There was a significantly higher amount of mink with injuries after 36 days pp (P < 0.001) (Figure 1[c]). There were nearly no injuries until 36 days pp, after which mainly kit injuries less than 10 mm in diameter were observed. There was no relationship between observation of injured adults and date of visit. Farm four had no observations of sticky kits or diarrhoea. To be able to run the analysis of the effect of kits’ age on the prevalence of diarrhoea, farm four is excluded from the analysis due to very few observations of sticky kits and diarrhoea. There was significantly higher prevalence of diarrhoea after about 34 days pp (P < 0.001) (Figure 1[d]).

Analytical results at WelFur criteria level

The calculated score of the WelFur criterion ‘Absence of prolonged hunger’ dropped significantly from 86 to 38 after 35 days pp, which is around five weeks pp (P = 0.001) (Figure 2). There was a slight decrease in the criterion score.
for 'Comfort around resting' with average kits' age (Figure 2), with a significant difference in the score after 35 days post-partum compared with earlier in the lactation ($P = 0.015$). There was no significant change in the criterion score ‘Absence of injuries’ at around 35 days post-partum ($P = 0.132$), but there seems to be a change later in lactation (Figure 2). The change in the Welfare score is due to an increase in kit injuries while there was no relationship between observation of injured adults and date of visit. There was a slight decrease in the Welfare score of the criterion ‘Absence of disease’ in the last period of lactation (Figure 2), but there was no significant difference between the scores before or after 35 days post-partum ($P = 0.370$).

**Welfare principle and overall category level**

The estimated overall score for the principles ‘Good feeding’ and ‘Good housing’ decrease significantly at around 35 days of kits’ age ($P = 0.001$ and $P = 0.016$, respectively), while the other principle scores did not change significantly with age (Figure 3). All the farms had their principle score values above 20, and at least two of the principles had score values over 55. Therefore, the estimated Welfare classification was ‘Good current practice’ for all farms during the whole nursing period.

When including the actual values for all measurements in the nursing period, the measurement of ‘Nest-box material and bedding/nesting material’ and ‘Cage enrichments’ changed significantly with kits’ age due to lack of straw at the end of the nursing period. This influenced the criterion ‘Thermal comfort’ but not ‘Expression of other behaviour’ significantly, while this was not enough to affect the estimated overall classification of farms (Figure 4).

**Discussion**

We accept the hypothesis that the body condition of the mink dam, the frequency of dirty nests, frequency of injuries and diarrhoea change significantly with the date of assessment within the data collection period from parturition to weaning, influencing the scores of Welfare at criteria level. We also accept, however, that as expected, these changes are not large enough to change the estimated overall classification for the farms between the dates of visit.

The effect that days post-partum have on the frequency of very thin dams corresponds with our expectation based on the knowledge of the dams reaching their upper limit for feed consumption at around four weeks of age (Hansen 1999). Figure 1(a) shows that all observations of very thin animals were after four weeks post-partum, and mainly at the end of the observation period. The score for the criterion ‘Absence of prolonged hunger’ is calculated from the percentage of very thin dams, and a drop in the criterion score as shown in Figure 2 corresponds to the higher frequency of very thin dams after about four weeks of lactation. Very thin dams have low welfare, and the Welfare assessment system accepts only a few percent in the sample before the score of welfare for this criterion is reduced dramatically (Welfare 2013). Therefore, the increase from no very thin dams to 15–40% of the sample (Figure 1(a)) explains the significant increase in the welfare score after 35 days post-partum.
Results: Paper I

Figure 2

Welfare score for the criterion of 'Absence of prolonged hunger' = ▲, 'Comfort around resting' = ●, 'Absence of injuries' = X and 'Absence of disease' = ■ in relation to date of assessment (Monsen et al 2012). Each dot represents the criteria score for one farm, except average kits age 22 which represents criteria score from two farms with identical score values. Welfare score 100 is the best score indicating high welfare, and score 0 is the lowest.

Figure 3

Estimates of Welfare scores of the four principles of welfare using average farm values except for the four welfare measurements under investigation: 'Body condition score' (BCS), 'Dirty nests', 'Injuries' and 'Diarrhoea inducing sticky kits'. The dark lines indicate the thresholds for the overall classification of mink farms. Every average day post-partum represents score values for one farm. Welfare score 100 is the best score indicating high welfare, and score 0 is the lowest. The principle of welfare: 'Good feeding' = ▲, 'Good housing' = ■, 'Good health' = ○ and 'Appropriate behaviour' = ●.

Figure 4

Estimates of Welfare scores of the four principles of welfare, using actual values for each farm for all welfare measurements. Every average day post-partum represents score values for one farm, based on the actual values of all measurements. Welfare score 100 is the best score indicating high welfare, and score 0 is the lowest. The dark lines indicate the thresholds for the overall classification of mink farms. The principle of welfare: 'Good feeding' = ▲, 'Good housing' = ■, 'Good health' = ○ and 'Appropriate behaviour' = ●.
Results: Paper I

drop in the calculated welfare score at the criteria level, as well as at the principal level.

When the kits are about four weeks old, all farmers in this investigation feed the mink on the lid of the nest-box to ensure access to food for the kits. The risk of dirty nest-box resting areas is confirmed in this study, where we found significant effect of the kits' age on the frequency of dirty nests. As the frequency of dirty nests is only one of four recorded resting qualities of the nest-box, and with the measurement 'Access to a nest-box' also contributing to the criterion 'Comfort around resting', the effect on the criterion score was low, even though it was significant.

We found that the frequency of injuries was significantly affected by the average age of the kit, but did not change the welfare score of the criterion 'Absence of injuries' from 35 days of age. A change in the frequency of injuries was expected. One of the farms visited at day 44 pp had significantly lower criterion score than the farms visited later in the lactation period, at day 51 and 52 pp. If the kits start fighting and the farmer observes injuries, the injured kits will be treated, moved or euthanised. Furthermore, the farmer may divide the litter into one group with the dam, and one group with the rest of the kits. Separating big litters will reduce the fighting and the amount of injuries (Clausen & Larsen 2012). Fighting amongst kits decreases after the kits have learned to drink around six weeks of age (Brink & Jeppesen 2005). However, as the three last visits were to three different farms, we cannot conclude if the difference in injuries after day 56 pp is a difference between the farms or a general difference with days pp. Therefore, specific investigations into the development in injuries during late lactation in mink will be needed to clarify this.

We found a significant effect of days pp on the prevalence of diarrhoea due to diarrhoea on one of the farms from 35 days pp. This change in prevalence of diarrhoea with age did not lead to any significant change in the score for the criterion 'Absence of disease'. Diarrhoea is one of four measurements that form the criterion 'Absence of disease', and the change in prevalence of diarrhoea would have to be larger in order to make a significant change at criteria level.

The criterion 'Absence of prolonged hunger' affects the principle score 'Good feeding', which is the principle with the lowest score value. The principle of 'Good health' did not vary systematically with days pp despite the variation in the measurement 'Injuries'. This is partly because the incidence was low and partly because 'Injuries' is only one of eight measurements included in the three criteria that constitute the principle.

In addition to the four measurements investigated in the present study, lack of bedding material late in the lactation period also had an influence on the score values. When the kits are fed on the lid of the nest-box from four weeks pp, the nest-box cannot be covered with bedding material to keep the nest-box warm. This reduces the welfare score for 'Nest-box material and bedding material' in WelFur. At the beginning of the nursing period, the need for bedding material is crucial for nest building to keep the kits warm; however, the importance decreases with the kits' age. At the end of the nursing period, the kits have grown quite big, have gained the ability to maintain their body temperature, will to some extent keep each other warm in the nest-box, and the average ambient temperature has increased. The kits are, therefore, less sensitive to cold and draught when fed on the lid of the nest box, and the risk of cold is lower. It can therefore be argued that lack of bedding material after four weeks pp has less influence on the welfare of the mink, and that it should not affect the overall score significantly. However, according to the present WelFur-Mink protocol, lack of bedding material increases the risk that the total number and magnitude of changes in late lactation could, in some cases, be sufficient to change the welfare score at the principal level or the overall category of welfare.

Ordinarily, the dams will lose bodyweight during lactation due to the high milk production and mobilisation of body fat reserves mainly after four weeks of lactation. In this period, very thin dams usually have sufficient feed but are unable to sustain the energy requirement for lactation without mobilising too much of their body reserves. This is a welfare problem for the actual animal, although the term 'Prolonged hunger' may seem an inaccurate description. It is important that the dam is in ideal condition for sustaining lactation without mobilising too much body reserves towards the end of lactation. This ability could be included in the breeding strategy.

Based on previous studies in the WelFur project, we knew that repeated data collection from four farms, with 120 dams and litters per farm, would be possible for practical reasons, and that this sample would be enough to show the overall picture of how the different WelFur score values and classifications change with the kits' age. As some of the measurements occurred very seldomly, a larger sample size would, however, have been preferable.

Implications for the assessment of animal welfare using the WelFur-Mink protocol

Estimation of the overall WelFur classification shows that no major changes in the welfare assessment are observed in the observation period. Consequently, there is no need for concern regarding the overall reliability of the assessment protocol developed to be robust and, as far as possible, independent of changes in the conditions during observation, such as observer identity, weather conditions, time of day and also date of assessment within the time window defined. However, the observed change in the four measurements we focused on, as well as in other measurements, indicates that changes in the overall WelFur classification could occur if these or other measures had changed a little more for the better or worse. Actually, such changes do happen when a 5% indifference threshold is applied to the principle score values before estimating the overall classification. This is normal procedure in Welfare Quality® to account for the uncertainty of the assessment. This will lead to a change in the classification from 'Best current practice'
Results: Paper I

to ‘Good current practice’ at the end of the lactation period for three of the four farms. If the assessment is to be fully independent of the day of assessment post-partum, it is therefore necessary to consider ways to handle the difference between assessment in the first and last part of the time window for all, or some, of the measurements. One option could be to limit the time window for welfare assessment to June (approximately 28 days pp until weaning). This would ensure that the main welfare risks can be assessed in a more reliable and robust manner. This would, however, drastically limit the feasibility of the Welfur-Mink protocol because the number of assessors needed to carry out the assessments would double and no longer correspond to the numbers needed for the other two annual assessments. Alternatively, a correction factor might be developed to correct for the date of assessment, especially regarding the dams’ body condition. This might be similar challenges in the other two production periods, with increasing risk of lower Welfur-score towards the end of the assessment period. If this is documented, another option could therefore be to stratify the visits so that all the farms have one visit in the beginning of an assessment period, one in the middle and one at the end of a period. If such options are not possible, then the acceptable variation in overall classification must be discussed in more detail in relation to the reliability of the protocol. This discussion should also consider the alternative of not including the nursing period in future Welfur assessment protocols.

Animal welfare implications

Our findings further contribute towards improving the overall reliability of the welfare assessment procedure of mink farms using the assessment system, Welfur, in the lactation period. Welfur assessment of mink farms can reveal to farmers challenges regarding the welfare of their mink and where this may be improved via procedural changes. Knowing the effect of the day of assessment post-partum will allow the mink farmer and his advisors to interpret the results correctly, and not disregard risk factors that were not prevalent on the day of assessment.

Conclusion

Our hypothesis that the body condition of the mink dam, the frequency of dirty nests, frequency of injuries and frequency of diarrhoea change significantly with the day post-partum within the period from parturition to weaning is shown to be true and, therefore, the Welfur score on criteria level, depends on the date of assessment. Estimation of a Welfur score per principle also indicates a change with the date of assessment. The overall category did, however, not change with days pp. Further analyses are needed to evaluate the need for reducing the time window for assessment, stratify the visits between the three periods or development of a valid correction factor, so that this important period can be maintained in the general Welfur assessment of mink farms.

Acknowledgements

This study was financed by Aarhus University and European Fur Breeders Association. We thank Bente Krogh Hansen and Maria Sylvest Bølsberg from Copenhagen Fur, and Steffen Werner Hansen and Jens Malmpvist from Aarhus University, Department of Animal Science for contributing with collecting data on the mink farms; Rodrigo Labouriau, Aarhus University, Department of Molecular Biology and Genetics, for statistical consultation; the farmers for their contribution with information and kindly letting us into their farm.

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4.2 Paper II

Classification of animal welfare on mink farms differs between three annual production periods
Running title: Mink welfare differs between the production periods

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Accepted to be published in Animal Welfare
Included in the thesis with permission from the journal’s editorial board
Abstract

According to the WelFur-assessment protocol for mink we need to assess welfare at three one-day visits, one in each of three main annual production phases. If one of these three assessments could provide a representative description of the welfare on a mink farm throughout the year we will save time and money and provide the farmer with an immediate result. As the manager is usually the same in all three phases of production and as most welfare problems in mink production are related to management we hypothesise that assessment in one of the three phases is sufficient for predicting the overall annual classification of welfare of a farm. Based on the WelFur-protocol for mink, data from 19 farms were collected in each of the three production phases: Breeders during winter (assessment period 1); Females and kits in lactation (assessment period 2); Juveniles during late growth (assessment period 3). The data were recorded by two external assessors per farm, on 9 farms in 2011 and 10 other farms in 2013, and an aggregated welfare assessment at farm level was calculated for each of the three visits. Data from the three assessments per farm were compared both at criteria-, principle-, and at overall classification level according to the Welfur-Mink concept. It appears that the estimated WelFur classification of farms differs between the assessment periods, especially due to low score-value of the principal “Good Feeding” in the summer period. Scores from period 2 and 3 are needed for predicting the full annual score of the four WelFur principles. Based on the present results we reject our hypothesis that the overall annual classification of welfare of a farm in the WelFur system can be based on one period. A simplification of the WelFur-assessment system may be possible, with excluding welfare assessment in period 1.

Keywords: animal welfare, labelling system, mink production, welfare score, welfare assessment, WelFur

Introduction

Mink production has a fixed annual cycle with three major phases of production: Preparation of breeders from selection in November to mating in March (phase 1), Reproduction from mating in March to separation in July (phase 2), and Growth from separation to pelting or selection (phase 3). There are different animal welfare challenges in the different phases of production. In phase 1 there is a risk of very thin animals due to conditioning of juveniles before flushing and mating (Møller 1992, Tauson 1993). There is also a risk of very thin animals at the end of phase 2, due to high milk
production and mobilisation of body reserves (Hansen 1999), and a risk of injured kits (Brink & Jeppesen 2005; Clausen & Larsen 2012). In phase 3 there is a risk of injuries, especially after the autumn equinox in group housed mink (Hansen et al 2014). The time window for assessing mink welfare within these phases have therefore been defined to the last 6-8 weeks of each phase, e.g. conditioning of breeders in January-February as assessment period 1, lactation and weaning in May-July as assessment period 2, and moulting and priming of the winter pelt in October-November as assessment period 3 (Mononen et al 2012).

WelFur is an on-farm welfare assessment system for foxes and mink, developed both for certification and advisory purposes (Botreau et al 2012, Mononen et al 2012). There are many different welfare assessment systems developed for different animals (Bartussek 1999, Blokhuis et al 2010, de Vries et al 2014, Edgar et al 2013, Lievaart et al 2005, Main et al 2007, Sorensen et al 2001, Vasseur et al 2015). Most of the welfare assessments systems, such as Welfare Quality® (Blokhuis et al 2010), are based on only one visit per farm in cattle, pig and poultry production. Kirchner et al (2014) claim that animal welfare classification should not be based on single assessments, but suggest repeated assessment to generate rolling averages or to verify assessments that would cause reclassification of farms. In strictly seasonal production systems, the result from a welfare assessment is very dependent on the time of visit (Moller et al 2003), and several visits will often be necessary to get an overview of the welfare in the different phases of production. A welfare assessment system for management and advisory purposes was developed and tested in Denmark during 1998 to 2002 (Moller et al 2003). The development of WelFur-Mink was initiated by the European Fur Breeders’ Association (EFBA) in 2009, in order to create a solid certification program to cover all European mink and fox farms. The system uses information from all the three phases of mink production, and is based on the principles developed in Welfare Quality® (Blokhuis et al 2010, Botreau et al 2007, Mononen et al 2012). Three annual assessments are time consuming and expensive, and there are still only few WelFur assessments conducted on the same farms in all three production phases, and mainly as part of research and development. If assessment in one of the three main production phases reflects the welfare in the other production phases, one visit would be enough to classify the farm in a labelling system such as WelFur.

Previous studies have shown that management play an important role for animal welfare on farms (Hemsworth & Coleman 2010, Sandoe et al 1997). In mink production, management procedures like inspection of the mink, number of mink per farm hand, strategies for feeding, separation and grouping of kits after weaning, and for treating or euthanizing sick or injured animals are found to be of great importance for the animals’ welfare (Møller & Hansen 2000). Despite the different
challenges in the three production phases, the farming system, the manager, and the farm hands are the same. These factors are paramount for the welfare of animals and we therefore expect that the welfare in the three phases are highly related.

The aim of the present study was to investigate whether a welfare assessment according to the WelFur-Mink protocol in only one of the three production phases, produces a reliable assessment of the welfare in a full annual production of a mink farm. The objective of the study was therefore to test the hypothesis:

The overall annual classification of welfare of a mink farm in the welfare assessment system WelFur can be based on assessment in just one of the three annual production phases.

Material and method

Farms and study sample
The result of the study is relevant for all the approximately 1450 mink farms in Denmark (2014). The study population was 19 mink farms in Central Jutland. Ten of the farms were visited in 2013 as part of a Ph.D. project. They were selected based on information about the farm management and the farmers’ interest or need for improvement in animal welfare, and motivation for joining a Stable school (knowledge exchange between farmers, a concept adjusted from Vaarst et al (2007) for test in mink farms (Henriksen et al in prep)). The farms should vary in size and in farmers’ experience with mink farming. All 10 farms had sections with climbing cages, which can house three or four animals in the growth period until pelting. The other nine farms were tested as part of the development of the WelFur protocol in 2011 (Mononen et al 2012, Møller et al 2012, Rousing et al 2012). The data from all 19 farms were recorded as cross-sectional data based on one visit on each farm in the assessment period within each of the three major phases of production.

The study sample was about 120 cages per farm per visit in assessment period 1 and 2, and 90 cages in assessment period 3 due to more animals per cage in this period. A sample of 120 cages is found to be enough to get a representative sample of animals from a mink farm, independent of farm size (Rousing et al 2012). The study sample was representative regarding colour type of mink, primi- or multiparous dams, and the different housing conditions on the farm at the day of visit. In assessment period 1 there is only one animal per cage and in period 2 it is typically a dam and her kits. In assessment period 3 it is typically two juveniles or a dam with one or two male juveniles in the cage, or three or four group housed juvenile females. Most farms pelt most of the males after the
mating period, but one of the farms in this study had kept enough male breeders to be included in the study sample in assessment period 2. The study unit was a farm.

Assessment, scoring and aggregation
Data were collected once per farm, in each of the three assessment periods according to the WelFur-Mink protocol. The data were obtained by two external assessors per farm, on 9 farms in 2011 and on 10 farms in 2013, and aggregated at herd level. One assessor did the main assessment, while the other recorded the results. Both assessors observed stereotypic behaviour. The assessors met to calibrate their assessment before each assessment period. Data from the three assessments per farm were compared both at criteria and principle level and on the overall WelFur classification as described below.

Each welfare measurement in WelFur is getting a score based on the registrations on each farm in each assessment period. The measurement scores are aggregated into scores within and across periods by use of Choquet integrals based on expert opinions as described in EFBA (2013), then into 12 criteria scores and a score for the four principles (Botreau et al 2012) (Table 1).

Table 1. The WelFur principles of welfare, with the underlying criteria and measurements (Henriksen & Møller in press).

<table>
<thead>
<tr>
<th>Principle</th>
<th>Criterion</th>
<th>Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Good feeding</td>
<td>1. Absence of prolonged hunger</td>
<td>Body condition score</td>
</tr>
<tr>
<td></td>
<td>2. Absence of prolonged thirst</td>
<td>Continuous water availability; measured by: Type of watering system, Functioning and cleanliness of the water points</td>
</tr>
<tr>
<td>2. Good housing</td>
<td>3. Comfort around resting</td>
<td>Access to a nest box, Resting quality of the nest box/resting area</td>
</tr>
<tr>
<td></td>
<td>4. Thermal comfort</td>
<td>Protection from exceptional weather conditions, Nest box material and bedding/nesting material</td>
</tr>
<tr>
<td></td>
<td>5. Ease of movement</td>
<td>Space available for moving (area and height)</td>
</tr>
<tr>
<td>3. Good health</td>
<td>6. Absence of injuries</td>
<td>Skin lesions or injuries to the body</td>
</tr>
<tr>
<td></td>
<td>7. Absence of disease</td>
<td>Mortality, Diarrhoea, Lameness or impaired movement, Obviously sick animals</td>
</tr>
<tr>
<td></td>
<td>8. Absence of pain induced by management procedures</td>
<td>Killing methods for pelting of mink, Killing methods for individual mink</td>
</tr>
<tr>
<td>4. Appropriate behaviour</td>
<td>9. Expression of social behaviours</td>
<td>Social housing in the growth period (period 3), Age and procedures at weaning in the summer period (period 2)</td>
</tr>
<tr>
<td></td>
<td>10. Expression of other behaviours</td>
<td>Stereotypic behaviour, Cage enrichments, Fur chewing</td>
</tr>
</tbody>
</table>

1The two criteria are based on the same measurements.
The scores have values between 0 (worst) and 100 (best). The overall classification of a farm in WelFur is based on the combination of the four principle scores into four categories: ‘Best current practice’, ‘Good current practice’, ‘Acceptable current practice’ or ‘Unacceptable current practice’.

The principle score values required to get classified into the different categories are shown in Table 2. The model for aggregation of the different principle scores into classification of welfare is depending on data from the assessment period in all three production phases. A correction factor is used to adjust for the difference in how important the different measurements are in the different assessment periods. In order to evaluate the effect of a single period on the classification of farms, we estimated the score values per period without weighing the measures between periods. The criterion “Expression of social behaviours” is based on information from assessment period 2 and 3 only. In the estimation of the seasonal principle score for “Appropriate behaviour” in assessment period 1 the criterion was set to the value 100.

**Statistical analysis**

Outcome variables:

- The overall classification of farms (ordinal outcome variables: best -, good -, acceptable - and not acceptable current practice)
- The four principle-scores (pseudo continuous outcome variables, with values from 0 to 100). Both the seasonal scores per assessment period and the full annual score
- The 12 criteria-scores (pseudo continuous outcome variables, with values from 0 to 100). Both the seasonal scores per assessment period and the full annual score

The main interest was to compare the correlation between score values of each of those outcomes between seasonal scores per assessment period and the full annual WelFur scores. This was done by using “Pearson’s product-moment correlation” in the statistical software R (R Core Team 2014). The limit for statistical significance was set to $P = 0.05$ in all tests.

**Table 2  WelFur-classification of farms regarding welfare (Revised from Mononen et al 2012).**

<table>
<thead>
<tr>
<th>Category</th>
<th>Required score values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best current practice</td>
<td>Score 55 on all four principles, and more than 80 on at least two</td>
</tr>
<tr>
<td>Good current practice</td>
<td>Score 20 on all four principles, and more than 55 on at least two</td>
</tr>
<tr>
<td>Acceptable current practice</td>
<td>Score 10 on all four principles, and more than 20 on at least three</td>
</tr>
<tr>
<td>Unacceptable current practice</td>
<td>If the minimum standard 'Acceptable current practice' is not met</td>
</tr>
</tbody>
</table>


**Missing data**

Missing data were treated in the following way: If information about social weaning (one farm) were missing, the mean value from the other farms in the same year of assessment was included. If information about thermal comfort was missing from one of the assessment periods (one farm in period 1, four farms in period 2 and three farms in period 3), the same value as another assessment period was included.

**Results**

*Principle score and overall classification of welfare*

The relationship between the full annual WelFur score and the estimated WelFur scores from assessments in the three annual production phases for the 19 farms is illustrated for each of the four WelFur principles in Figure 1. The hypothesis is illustrated by a correlation of one and the deviation from this is illustrated as the distance of the scores from the straight line. The distance seems to be lowest for values in assessment period 2 for the principle of “Good feeding” and “Good housing”, and in period 3 for the principle of “Good health”. It is difficult to see which assessment period that have the lowest distance for the principle “Appropriate behaviour”. The estimated WelFur classification of farms, based on the mean principle scores of the 19 farms, in the three production phases was “Best current practise” in phase 1 and 3, and “Good current practise” in phase 2 (see Table 2 and Table 3). The overall annual WelFur classification was “Good current practise” for all farms.

The mean principle score-values of the 19 farms in the different assessment periods and correlations between the estimated seasonal score values and the full annual WelFur scores are shown in Table 3. The assessment period with the lowest mean seasonal score value for the different principles is the assessment period that has the highest correlation with the full annual WelFur score, except for the principle of “Appropriate behaviour”.

The estimated score values of the principle “Good feeding” in assessment period 2 were correlated with the full annual WelFur scores, while the estimated score values of the principle “Good housing” were correlated with the full annual WelFur scores in both assessment period 1, 2 and 3, with the highest correlation with period 2. The estimated score values of the principle “Good health” in assessment period 1 and 3 were correlated with the full annual WelFur scores, with the highest correlation with period 2. Period 2 and 3 in relation to the principle of “Appropriate behaviour” were correlated with the full annual WelFur scores.
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Figure 1

a) Good feeding

![Graph showing the relationship between full annual WelFur score and estimated seasonal WelFur score for Good feeding.]

b) Good housing

![Graph showing the relationship between full annual WelFur score and estimated seasonal WelFur score for Good housing.]

c) Good health

![Graph showing the relationship between full annual WelFur score and estimated seasonal WelFur score for Good health.]

d) Appropriate behaviour

![Graph showing the relationship between full annual WelFur score and estimated seasonal WelFur score for Appropriate behaviour.]

The estimated seasonal WelFur scores and the full annual WelFur score of the principles of a) Good feeding, b) Good housing, c) Good health and d) Appropriate behaviour in the assessments of the three annual production phases and the full annual score. The WelFur scores for assessment period 1 = ▲, assessment period 2 = ■, assessment period 3 = △.

Table 3. Mean WelFur principle score values with standard deviation and correlations between the estimated seasonal scores and the full annual WelFur score for the 19 farms in the minks three annual production periods (1. conditioning of breeders in February, 2. lactation and weaning in May-July, 3. moulting and priming of the winter pelt in October-November), and the full annual WelFur score. WelFur score 100 is the best score indicating high welfare, and score 0 is the lowest.

<table>
<thead>
<tr>
<th>Principle</th>
<th>Full annual score</th>
<th>Period 1</th>
<th>r_1</th>
<th>Period 2</th>
<th>r_2</th>
<th>Period 3</th>
<th>r_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good feeding</td>
<td>56 ±9</td>
<td>78 ±23</td>
<td>0.17*</td>
<td>48 ±17</td>
<td>0.86***</td>
<td>95 ±8</td>
<td>-0.23*</td>
</tr>
<tr>
<td>Good housing</td>
<td>78 ±10</td>
<td>84 ±5</td>
<td>0.50*</td>
<td>78 ±11</td>
<td>0.96***</td>
<td>86 ±3</td>
<td>0.56*</td>
</tr>
<tr>
<td>Good health</td>
<td>74 ±7</td>
<td>87 ±5</td>
<td>0.49*</td>
<td>84 ±7</td>
<td>0.40*ns</td>
<td>69 ±10</td>
<td>0.96***</td>
</tr>
<tr>
<td>Appropriate behaviour</td>
<td>56 ±4</td>
<td>57 ±6</td>
<td>0.15*</td>
<td>66 ±6</td>
<td>0.53*</td>
<td>63 ±7</td>
<td>0.68*</td>
</tr>
</tbody>
</table>

Significant correlation: * P < 0.05, ** P < 0.001, *** P < 0.0001, ns = not significant
Criteria scores of welfare

An overview of the mean WelFur criteria-score values from assessment of the 19 farms in the three production phases and the full annual scores, and the correlations between the seasonal scores and the full annual scores are given in Table 4.

The criterion scores of “Absence of prolonged hunger”, “Comfort around resting” and “Thermal comfort” in assessment period 2 were correlated with the full annual WelFur scores.

The estimated criterion scores of “Absence of disease” and “Good human animal relationship/Positive emotional state” in assessment period 3 were correlated with the full annual WelFur scores.

Table 4. Mean WelFur criterion score values and standard deviation and correlations between the estimated seasonal scores and the full annual WelFur score for the 19 farms in the minks three annual production periods (1. conditioning of breeders in February, 2. lactation and weaning in May-July, 3. moulting and priming of the winter pelt in October-November), and the full annual WelFur score. WelFur score 100 is the best score indicating high welfare, and score 0 is the lowest.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Full</th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
<th>r1</th>
<th>r2</th>
<th>r3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absence of prolonged hunger</td>
<td>56 ±20</td>
<td>70 ±33</td>
<td>51 ±36</td>
<td>93 ±11</td>
<td>0.25*</td>
<td>0.85**</td>
<td>-0.069*ns</td>
</tr>
<tr>
<td>Absence of prolonged thirst</td>
<td>68 ±01</td>
<td>99 ±61</td>
<td>64 ±01</td>
<td>100 ±01</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort around resting</td>
<td>98 ±4</td>
<td>99 ±1</td>
<td>99 ±5</td>
<td>99 ±5</td>
<td>0.15*ns</td>
<td>0.99***</td>
<td>-0.074*ns</td>
</tr>
<tr>
<td>Thermal comfort</td>
<td>76 ±20</td>
<td>92 ±12</td>
<td>78 ±23</td>
<td>98 ±2</td>
<td>0.29*ns</td>
<td>0.90**</td>
<td>0.12*ns</td>
</tr>
<tr>
<td>Ease of movement</td>
<td>79 ±5</td>
<td>79 ±5</td>
<td>79 ±5</td>
<td>79 ±5</td>
<td>1***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absence of injuries</td>
<td>86 ±4</td>
<td>89 ±8</td>
<td>90 ±6</td>
<td>88 ±6</td>
<td>0.73**</td>
<td>0.65*</td>
<td>0.71**</td>
</tr>
<tr>
<td>Absence of disease</td>
<td>70 ±8</td>
<td>88 ±6</td>
<td>82 ±9</td>
<td>64 ±11</td>
<td>0.42*ns</td>
<td>0.40*ns</td>
<td>0.96***</td>
</tr>
<tr>
<td>Absence of pain induced by management procedures</td>
<td>100 ±01</td>
<td>100 ±01</td>
<td>100 ±01</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Expression of social behaviours</td>
<td>64 ±14</td>
<td>-</td>
<td>80 ±9</td>
<td>62 ±5</td>
<td>0.64*</td>
<td>0.58*</td>
<td></td>
</tr>
<tr>
<td>Expression of other behaviours</td>
<td>46 ±8</td>
<td>32 ±7</td>
<td>60 ±15</td>
<td>72 ±10</td>
<td>0.86***</td>
<td>0.75***</td>
<td></td>
</tr>
<tr>
<td>Good human-animal relationship</td>
<td>65 ±8</td>
<td>70 ±9</td>
<td>73 ±7</td>
<td>67 ±12</td>
<td>-0.29*ns</td>
<td>-0.078*ns</td>
<td>0.94***</td>
</tr>
<tr>
<td>Positive emotional state</td>
<td>65 ±8</td>
<td>70 ±9</td>
<td>73 ±7</td>
<td>67 ±12</td>
<td>-0.29*ns</td>
<td>-0.078*ns</td>
<td>0.94***</td>
</tr>
</tbody>
</table>

Significant correlation: *P < 0.05, **P < 0.001, ***P < 0.0001, ns = not significant

1 Not tested for correlations due to no variation in data.

2 Expression of social behaviours is only relevant in period 2 and 3, and is not measured in period 1.
The estimated score values of criterion scores of “Absence of injuries” did correlate with the full annual WelFur score for all assessment periods.

The estimated criterion scores of “Expression of other behaviours” in assessment period 1, 2 and 3 were correlated with the full annual WelFur score.

The criterion score “Expression of social behaviour” was measured only in assessment period 2 in relation to the weaning procedure, and in period 3 in relation to social housing. The seasonal scores were correlated with the full annual score.

The criterion scores of “Absence of prolonged thirst” did not differ between farms, except one farm in assessment period 1 (Table 4). Due to lack of variation in data in assessment period 2 and 3 we could not calculate any correlations.

The criteria “Ease of movement” and “Absence of pain induced by management procedures” did not differ between farms or periods.

**Discussion**

The present study shows that the overall WelFur-classification differs between the three production phases. This was especially due to farms with very thin animals and a resulting low score-value of the principal “Good Feeding” in observation period 2. The hypothesis that assessment in just one of the minks’ three production phases can predict the overall annual WelFur classification of welfare is therefore rejected.

It seems possible to predict the full annual score of the four WelFur principles from the two seasonal scores in production phase 2 and 3, without information from production phase 1. This is due to the high correlation found between the seasonal scores in assessment period 2 and the full annual WelFur scores for the principles of “Good feeding” and “Good housing”, and between the seasonal scores in assessment period 3 and the full annual WelFur scores for the principle of “Good health” and “Appropriate behaviour”. The correlation between the seasonal score in period 1 and the full annual score is significant for the principle of “Good housing” and “Good health”, but the correlations are quite low.

The complexity of welfare qualification may be illustrated by the lower WelFur score in assessment period 2 than in assessment period 1 and 3, which is primarily due to the principle ‘Good feeding’ (Table 3) including the criterion ‘Absence of prolonged hunger’ and ‘Absence of prolonged thirst’
Results: Paper II

(Paper II). Prolonged hunger is measured by body condition, for which the general recommendation in assessment period 1 is animals in moderate body condition score (BCS) 2 before mating, in order to be able to reproduce well and respond to flushing (Tauson 1993). If the farmer manages to avoid too thin animals (BCS 1) this will give a high WelFur score in period 1. At the same time, this can increase litter size and thereby increase the risk of very thin animals in assessment period 2 (Hansen 1999, Hansen & Berg 1998) resulting in a low WelFur score. This implies that good management practice in one phase of production can increase the risk of low welfare in another phase, and thus that the WelFur scores in different assessment periods are not necessarily positively correlated.

A management focus and interest within the production might also result in different impact of management on the animals’ welfare in the three production phases in different criteria and principle. The high profitability in having a high litter size and large pelts (Lagerkvist 1997) might lead to a focus on feeding in production phase 1 to ensure a successful reproduction and large litters and a high feed level in period 3. Feeding for high litter size in phase 1 might, as already mentioned, potentially increase the risk of thin dams in production phase 2. Feeding for large pelts by a high feed level in production phase 3 might increase the risk for obesity and fatty liver (Dick et al 2014), which might increase the risk of mortality. So, focus on feeding management might have different effects on the WelFur score in different phases of production.

The WelFur assessment of mink is merging the information from the assessed welfare of adult dams and males selected for breeding, nursing dams and their kits before weaning, and juveniles and dams during the growth season into a common welfare score per measurement per farm. This differs from other welfare assessment systems, like the Welfare Quality’s assessment system for pig (Welfare Quality 2009) were different phases of the production, e.g. reproduction (sows and piglets) and growing animals (growing and finishing pigs) are assessed separately in different welfare assessments. Another difference is that different types of animals are included in each phase of the WelFur-Mink assessment, i.e. period 3 includes mainly juveniles but adult dams are also present at the farms and included in the assessment. In pig production unit, sows and piglets are usually separated from growing and finishing pigs, sometimes on different farms and often with different stockmen, and a common welfare score is less relevant. In mink production, however, the whole production cycle occurs on the same farm, and the same animals are present in different periods and therefore a correlation between the assessments could have been expected.

Although assessment in one production phase cannot tell the whole story about welfare in mink, some reduction of the assessment procedure might be possible due to correlations between the full
annual WelFur score and several criteria scores related to the different principles (Table 1). As shown in Table 4 the criterion “Absence of prolonged hunger” in assessment period 2 was highly correlated with the full annual score, and the criterion “Absence of prolonged thirst” was similar in all three assessment periods. Therefore assessment of body condition and parameters related to “Absence of prolonged thirst” might be reduced to assessment only in period 2. The seasonal score values in assessment period 2 were highly correlated with the full annual WelFur scores for the criterion “Thermal comfort”, indicating that for this criterion assessment only in period 2 might be sufficient.

The criterion “Comfort around resting” is based on information about access to a nest box and resting quality of the nest box/resting area, and the scores in period 2 were highly correlated with the full annual WelFur score. Access to the nest box can be a problem in the growth period for very large mink in group housing. This was not a problem at the farms in our study, and therefore it could be an argument for not including “Comfort around resting” in assessment period 3.

The criterion “Ease of movement” had the same value in all three assessment periods, and could, therefore, be measured in one period only. The best choice would be period 3 where there might be mink in cages for group housing where this measurement is most demanding to fulfil. The full annual WelFur scores of the criterion “Absence of disease” are highly correlated with the estimated score values in assessment period 3. The correlation with period 1 is small and parameters related to the criterion might be unnecessary to measure in assessment period 1 or 2. The criterion “Absence of pain induced by management procedures” had the same value in all three periods. The measures related to this criterion are killing methods for pelting and for individual mink and might, therefore, be most relevant to measure in assessment period 3 where the mink are going to be pelted. The full annual WelFur scores of the criteria “Good human animal relationship/positive emotional state” are highly correlated with the estimated score values in assessment period 3, and might be unnecessary to measure in assessment period 1 or 2. The criterion “Expression of social behaviours” seems to be dependent on information from both assessment period 2 and 3, and the criterion “Expression of other behaviours” on information from all three assessment periods.

The assessment period with the lowest criterion score was in most cases the period with the highest correlation with the full annual score. This was expected due to the method of aggregation of sub scores where the lowest sub-score will have the highest influence on the full score value (Botreau et al 2012, EFBA 2013). The criteria scores that are more or less unchanged between the three annual
seasons, as shown in Table 4, are based on resource based measures that are not very dependent on daily farm management throughout the year.

The present study did not find any farms to be classified as “Unacceptable current practice”. This might indicate that the variation between the farms in the study was small for investigating the effect of farm specific management. The farms were selected based on the farmers interest in or need for improving animal welfare. This might have led to a selection of farmers with earlier sanctions or general problems regarding animal welfare on their farm, and/or to farmers that are generally interested in new knowledge. Ten of the farmers in the study were interested in joining a Stable school, which is knowledge exchange between farmers with focus on animal welfare. Farmers with great animal welfare problems do often hide their production problems both for their surroundings and themselves (Andrade & Anneberg 2014) and would probably not join such a group where problems are displayed and discussed in order to find solutions with other farmers. This could favour farmers with good animal welfare and low variation in score values between farms and periods, and make it easier to find correlation between seasonal score values and the full annual score. Although the variation between farms may not fully represent the Danish production we did find a significant variation in score values both between farms and assessment periods. Large scale assessments in Denmark will be needed in order to display the true variation between farms, and thus how representative our sample was.

The fact that ten of the farms were joining a Stable school where specific problems regarding welfare on the respective farms were discussed, could have led to an improvement of welfare from the first to the last visit. The nine farms from 2011 would adjust for this, and the results from the 10 farms did not differ from the nine farms in welfare change from the first to the last visit.

**Animal welfare implications**

The results of the study contribute with knowledge to simplify the welfare assessment procedure of mink farms with the assessment system WelFur. An easy and effective assessment of farms is important if the system shall be implemented in practical mink production. WelFur assessment of mink farms can help the farmers in revealing challenges regarding their mink welfare, and what to change in order to improve the welfare. Comparing results between farms, or between years, might motivate farmers to aim for the highest animal welfare on their own farm.
Conclusion

The hypothesis that “The overall annual classification of welfare of a farm in the welfare assessment system WelFur can be based on assessment in just one of the minks’ three production phases” was rejected. The results indicate that the overall classification of mink farms regarding animal welfare, with the assessment system WelFur, can be estimated from welfare assessment in production phase 2 and 3, and that further simplification of the WelFur assessment might be possible. The assessment of measures related to the criteria “Absence of prolonged hunger”, “Absence of prolonged thirst”, “Thermal comfort”, and “Comfort around resting” might be reduced to assessment only in period 2 and assessment of measures related to the criteria “Ease of movement”, “Absence of disease”, “Absence of pain”, and “Good human animal relationship/positive emotional state” only in period 3.

Acknowledgements

This study was financed by Aarhus University and European Fur Breeders Association. We thank Maria Sylvest Blæsbjerg and Bente Krogh Hansen from Kopenhagen Advice and Birthe Houbak from Aarhus University, Department of Animal Science for contributing with collecting data on the mink farms; The farmers for their contribution with information and kindly letting us into their farm.

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4.3 Paper III

Farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare

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Submitted to Livestock Science

Livestock Science states in its Guide for Authors under Submission declaration and verification that authors may submit an article that is published in an academic thesis
Abstract

The aim of the study was to explore farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare. Stable schools are knowledge exchange between farmers working towards a common goal, being able to give practical advice to each other. The concept is based on farmer field schools, developed and used in developing countries. Several Danish mink farmers are familiar with erfa-groups which also are farmers meeting, often with an advisor taking part, but the stable schools with only farmers and a facilitator have never been tested on mink farms.

In 2013, we therefore established two stable schools with farmers from five Danish mink farms in each group. The meetings were on the respective farms, and every farm was visited once within a year. The host-farmer presented one success story and two challenges he/she wanted to work with and get contributions to from the group. Qualitative interviews were conducted with the farmers to evaluate their perception of stable schools.

Based on the results from the study, and results from other studies of stable schools, we can conclude that farmers generally are positive to the structural way of working in stable schools, and that motivation for working towards a common goal is very important for the process of common learning among the farmers. The uniform production system at mink farms gives special challenges in how to work with the different subjects to ensure farmer ownership of the process. The farmers did not see the seasonal production as any constraint, but express that they like to work with the specific problems and challenges related to the respective production periods.

Keywords

Qualitative study, animal welfare, mink production, knowledge exchange, stable school, common learning
1. Introduction

Animal welfare has become an important issue for consumers around the world and especially in Europe, with an increasing concern about the welfare of animals in the farming industry (European Commission, 2007). There are different understandings of animal welfare among stakeholders (Evans and Miele, 2007; Sorensen and Fraser, 2010; Spooner et al., 2014; Vanhonacker et al., 2008; Velde et al., 2002), including the purpose of production as an important aspect of many people’s views concerning the use of animals by human beings (Knight and Barnett, 2008). In Denmark and other countries, several initiatives have been implemented to ensure the welfare on mink farms, like extensive legislation in European countries, based on the Council of Europe recommendations (1999) or Code of practice for mink production (Anonymous, 2011; National Farm Animal Care Council, 2013), and extra campaigns and inspections from the authorities (Danish Centre for Animal Welfare, 2012). Welfare assessment systems for mink production have also been developed (WelFur-Mink), mainly for certification (Mononen et al., 2012) and assessment intended for decision support (Møller et al., 2003). In this study, farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare is explored, but first we will focus on intervention and improvement of animal welfare on farms in general and on how welfare assessment can contribute to this.

Interventions for improving animal welfare in farm animal systems have often failed despite reliable and feasible assessment systems (Valeeva et al., 2007; Whay, 2007; Whay and Main, 2010). Therefore, there has been an increasing body of research published on how to move from assessment of on-farm animal welfare with identification of risk factors towards actual intervention for animal welfare improvements on farms (Tremetsberger and Winckler, 2015; Whay, 2007).

On-farm welfare assessment can contribute with determining priorities for intervention and can give information about the severity of problems (Grandin, 2010). Involving the farmer in the whole process is found to be an important criterion for animal welfare improvement (Whay and Main, 2010). Participation will help the farmer to understand the welfare problem and give the farmer ownership of the process by generating own ideas for possible and practical solutions.

Health and welfare planning is a continuous process in farm management with on-farm welfare assessment to identify risk factors, feedback and planning, development and implementation of interventions and review and evaluation with new assessment. This kind of planning is found to be a promising way to encourage farmers to implement changes on their farm for the benefit of the animals’ welfare process (Leeb et al., 2011; Tremetsberger and Winckler, 2015). Several principles
for a successful interactive planning approach have been defined for organic production, with a main focus on the farmers’ involvement (Nicholas et al., 2008; Vaarst et al., 2011). External input like advice from a colleague, veterinarian or advisor has also been identified as an important principle, showing to be feasible for health and welfare planning, in face-to-face advisory situations with a farmer and an external advisor as well as in discussion groups like stable schools (Ivemeyer et al., 2012).

Stable schools are knowledge exchange between farmers working with similar challenges being able to give practical advice to each other (Vaarst et al., 2007). The concept is based on Farmer field schools (FFS), developed and used in developing countries (Vaarst, 2007), and on the principle of common learning. Common learning is about learning as a group, working step by step with the participants’ own problems towards a common goal or aim. The basic idea is that a person is learning the most when reflecting and handling in relation to his/her own reality and develops the necessary knowledge him/herself (Vaarst et al., 2007), and this is in line with the principles for an interactive animal health and welfare planning.

Farmer field schools are based on common learning, and there is no so-called “expert” like veterinarians or advisors from an advisory service taking part in the meetings, but only a facilitator leading the process. The farmers are learning from and giving advice to each other and are all in the same situation with equal rights to tell about experiences, give opinions and be able to contribute. Two principles of the FFS is that “only the learner him/herself can discover and describe what is relevant and meaningful” and “learning is a consequence of experience” (Vaarst et al., 2007). In stable schools, the farmers are therefore deciding themselves what to work with and what to implement of changes to reach the common goal or aim of the group.

Different discussion groups are common in animal production in many countries. These groups are often farmers meeting with an advisor, discussing issues related to the actual period of the production. In Denmark, such groups are called “erfa-groups” (‘erfa’ stands for the Danish word ‘erfaring’, which means experience). As a contrast to the stable schools, where the participants are equal, a professional (like a vet or an advisor) will, according to Bourdieu (1990), dominate the non-professional through the authority of his own profession. Depending on equal trust and practical relevance of the advice for their own farm, the farmer might follow the professional’s advice (Vaarst et al., 2007). However, equality between participants is emphasised as an advantage within stable schools when compared with other discussion groups. The fact that the farmers own the process, choose their own problems and aims to work with is another advantage which is found
Results: Paper III

to be very important for implementing changes and welfare improvements on farms (Ivemeyer et al., 2014; Vaarst et al., 2007). Stable schools are found to be useful in improving animal health in dairy production (March et al., 2014; Vaarst et al., 2007). There are also some positive experiences within sheep and pig production (Hektoen and Sogstad, 2011; Studnitz, 2014). Different stable schools have been working with different health and welfare issues, for example phasing out antibiotics from their herds through promotion of animal health and reducing the use of allopathic medicine on organic dairy farms through animal health and welfare planning (Bennedsgaard et al., 2010; Ivemeyer et al., 2012; Ivemeyer et al., 2014; Vaarst et al., 2007). Currently, stable schools have been used in farm animal extension systems on themes such as animal health in dairy production (March et al., 2014), sow mortality (Studnitz, 2014) and calf health (Nielsen, 2009b). Many of the improvements implemented on farms were typically basic management routines being effected in a way that was useful for the specific farmer and in line with the farmer’s priorities, as especially mentioned by Bennedsgaard et al. (2010).

Mink production is a seasonal production, where the animals are strictly synchronised, both within and between farms. The production is therefore often divided into three phases with different welfare challenges in each phase (Henriksen et al., Submitted; Mononen et al., 2012; Møller et al., 2003): Breeders in the winter period preparing for mating in March (phase 1), reproduction period from mating in March to separation in July (phase 2) and growth period for juveniles from separation to pelting in November/December (phase 3). The seasonality might be a challenge or an opportunity in a stable school where issues discussed might not be relevant until the same production phase reappears the following year (Møller et al., 2003; Møller and Sørensen, 2004). This might render the discussions less focused or provide ample time for disusing, analysing and gathering information for a solution to be implemented next season. However, this seasonality issue is not mentioned in stable schools in sheep production (Hektoen and Sogstad, 2011).

The more problem oriented and committed concept of stable schools, in which farmers find their own solutions assisted by a facilitator, has not been tested on mink farms. Management plays an important role for animal welfare on farms (Hemsworth and Coleman, 2010; Sandoe et al., 1997; Møller, 1998), and in mink production this is related to inspection of the mink, number of mink per farm hand, strategies for feeding, separation and grouping of kits after weaning and for treating or euthanizing sick or injured animals (Møller and Hansen, 2000). Positive experiences with stable schools in other farming productions indicate that stable schools might be a method to increase mink farmers’ knowledge related to management to improve animal welfare. So far, stable schools in seasonal productions have not addressed the potential positive or negative effects of seasonality.
on the farmers’ perception or work with specific problems in stable schools. Therefore, we expect that stable schools can be useful for implementing management routines that differ between farms, and especially regarding complex welfare challenges with no simple generic solutions. We further expect that problems that are shared between most farmers, and that reappear almost every year, are more likely to generate a long lived interest and warrant expert knowledge from outside the stable school, in order to find solutions that can be implemented locally, than more sporadic problems.

The present study aims to explore the concept of stable schools as a management tool on mink farms. An actual improvement of welfare as a result of a stable school might not be present until one or two years after the stable school due to the seasonal production. Still, first of all, it is important to examine a system found useful by farmers to ensure farmer ownership. Hence, the objective of this study was to explore the farmers’ perception of stable schools as a tool to improve management for the benefit of mink welfare. The question was therefore: ”How do farmers perceive stable school as a tool to improve management for the benefit of mink welfare?”

2. Materials and methods

2.1. Selection of farmers

To get a broad picture of different opinions and views of the research question, with argumentations and explanations for these, the selection of farmers was aiming at finding maximum variation in farmer opinions. The farmers selected for the interview were farmers from 10 commercial mink farms selected for both stable schools and a project about the welfare assessment system WelFur-Mink (Henriksen et al. 2015). The farms were selected in collaboration with two veterinarians in central Jutland. Our interest was to find farmers with potential welfare problems in the mink’s growth period, based on the following four criteria:

1. The farmer should be interested in improving animal welfare on their farm.
2. The farms should vary in farm size and in farmers’ experience in mink farming, and the farmers should have no or low experience with former research projects.
3. All the farms should have sections with climbing cages that can house three or four animals in the growth period until pelting, which potentially would be farmers with welfare problems due to increased risk of injuries in this period (Hansen et al., 2014).
4. The farmers should both be motivated for joining a stable school with focus on improving animal welfare and for joining the welfare assessment system project. The two veterinarians were asked to identify potential farmers for two separate stable schools, one in each of the vets’ district.
The veterinarian made the first contact with the farmers and gave them information about the projects. After that, the farmers were called by phone and asked if they wanted to join the projects.

Thirteen farmers from 10 farms joined the stable schools. Two of the farmers (husband and wife) both had full-time work at the same farm and did both join the stable school. On two of the other farms, the husband had the main responsibility, but the wife joined several of the stable school meetings. On the rest of the farms, only one person joined per farm. The farmers differed in age and in how many years they had been working with mink. One of the farmers did not have his own farm but was working on one of his father’s and uncle’s farm, whereas some of the others had been mink farmers for over 20 years. The farm size varied from 1365 – 5000 dams.

2.2. Establishing stable schools

The farmers from the ten mink farms were divided into two stable schools, one in each of the two districts. The stable schools were conducted according to Vaarst et al. (2007), except with only one visit per farm: A stable school shall have a common goal or aim to work towards. The common goal in the present stable schools was to improve the mink’s welfare. The farmers chose two problems each from their own farm that they wanted to work with to improve the animals’ welfare and one success story they wanted to tell the other farmers. The stable school meetings took place on the group members’ respective farms, and the host farmer and his/her chosen problems were in focus. The members of the group were asking questions and giving advice to the host farmer, all being equal experts. The first author was the facilitator of the two groups. The facilitator did not contribute with any knowledge in the group discussion, but helped the host farmer with determining the agenda for the meeting, guided the process and the discussion and made both the invitations and minutes from the meetings. The minutes stated what kind of initiatives the host farmer would like to work with based on the suggestions from the other farmers in the group. Every stable school meeting started with a visit to the farm, looking at the host farmer’s mink and production system. After that, the group discussed the host farmer’s two problems and were presented to the success story, if this had not been presented on the farm. The discussions were structured with questions and suggestions around the table, with one person talking at a time, to ensure that all participants would have the opportunity to say what they wanted. The meetings were 2.5 – 3 hours long, including a coffee break or lunch.

2.3. Interviews

After one-year process with five stable schools per group and one visit on every farm, the farmers were interviewed. The couples working at the same farm were interviewed together. The interviews
were semi-structured qualitative interviews, using the phenomenological approach as described in Kvale and Brinkmann (2009). This means a focus on questions that reveal the farmer’s experiences with a specific phenomenon in the way he or she experiences it (Bevan, 2014; Kvale and Brinkmann, 2009). The interviews were based on an interview guide with topics and suggested questions as shown in Table 1. They were conducted face to face, tape recorded and lasted for about one hour.

The interviews were transcribed in a written style in the qualitative analysis software Transana 2.50 (2013). The analytical approach was phenomenological based meaning condensation (Kvale and Brinkmann, 2009). The meaning for each theme-coded meaning unit was summarised, and the quote was rewritten in our own words (short and precise). In that way, long statements were compressed into briefer statements that contained the main sense of what was said.

3. Results

The farmers’ experiences and perceptions of stable schools can be described by four main topics: “Motivation”, “Experiences”, “Changes during the process” and “How to improve” (Table 1). The “Motivation” was about how motivated the farmers were for joining the project, what their expectations and their motivation for working with the common aim of improving animal welfare were. The “Experiences” were about how they experienced the process, like planning the stable schools, discussions and outputs, stable schools in relation to seasonal production and compared with erfa-groups. “Changes during the process” was about changes in management in relation to the

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<td>Motivation</td>
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<td>4. Good to talk things through</td>
<td>7. Positive experiences</td>
<td>12. Changes that were implemented</td>
<td>14. Season is important</td>
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<td>11. Seasonal production</td>
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Table 1. Four main topics and themes of mink farmers’ perception of stable schools
animals’ welfare, what kinds of changes were implemented or why changes were not implemented at all. “How to improve” was about suggestions for improvements and general thoughts about stable schools in mink production.

3.1. Motivation

Before entering the project, the farmers received some information about stable schools from the veterinarian and from the first author. The farmers’ motivation for joining the project can be described through three themes, as illustrated in Table 1.

**Good to talk things through**

One motivation for joining the stable schools was to get good ideas and knowledge, from other farmers, which could be implemented on their own farm. The opportunity to exchange knowledge with other farmers, both to give and get, was seen as important. It was pointed out that sometimes it is just good to talk things through. Getting to know new people and be social was also mentioned as a motivation.

Farmers who were familiar with or were joining an erfa-group saw the stable school as another erfa-like group with a bit more structure and mentioned this as their reason for joining the stable school. The benefit of seeing other farms and compare their animals with your own was also emphasised.

> “It can be good to share with others in such groups. Otherwise, you might keep on doing it the way you have always done, although there is possibly a smarter and better way” (Farmer 2).

One of the farmers was quite new in mink production and saw this project as an opportunity to get new knowledge into the farm and to learn from more experienced farmers. Farmers who had been working with mink in many years did not necessarily see any great problems on their farm, but saw the possibility in showing others how they are working and in that way help other colleagues:

> ” (Question: What were your expectations?) To get something out of it and show others what we are doing at our farm” (Farmer 7)."

**Curiosity**

Stable schools were also seen as something new, something that seemed different from other kinds of meetings or discussion groups. This made farmers curious and was one reason for joining the
project. Farmers emphasised that they were generally interested in what is happening within mink production and what is new:

“It was to be able to learn something, to be wiser on something. It is always so. We are always curious. I think in mink breeding, we have always told if we think we have a good idea. Mink farmers have always shared a lot with each other I think. Different knowledge, practical tricks and things like that. So it is ..... although, there are also many things we do differently. Trifles. There are many funny things you can learn something from” (Farmer 8).

Motivation for the common theme “Animal welfare”

All the farmers expressed that they were motivated for working with animal welfare. Some more than others, but they were all aware of the importance of improving the animals’ welfare:

(Question: Did it mean anything to you (for joining the project) that the subject was about animal welfare?) "Yes, it did (matter that it was about welfare (for why joining the project)). Because it was in the media at that time, and there were extra control of farms etc. So it did. This is something that must be perfectly in order on our farms. Both for our own sake and to stop the media storm" (Farmer 4).

Farmers would like to include other issues as well, like economy or practical things regarding employees on the farm:

"Yes, I would have included something more. I would have liked a little more about economy ... and also about having employees for example, and things like that ... how to address it, how many (mink) you should have to make it profitable to have one employee and what you can let them work with, how old should they be, or how much knowledge should they have to be useful, and... "(Farmer 3).

3.2. Experiences

In connection to the second main topic “Experiences ” we found five themes: “Positive experiences”, “Negative experiences”, “Stable school contrary to erfa-groups”, “Finding themes/problems” and “Seasonal production”, see Table 1.
Positive experiences

The farmers’ positive experiences of the stable schools can be described through the four themes: “Meeting colleagues”, “Structure”, “External inputs from WelFur” and “Output”.

Meeting colleagues

The farmers were generally happy about meeting other colleagues. It was nice to come out and see other farms, and also pleasant to show their own farm to colleagues. One farmer argued that one of the farmers’ main problems is that they do not see each other’s farm, if they are not in an erfa-group:

"Anyway, I think the stable school meetings have been good in the way that you get someone else to look at your farm. For that's basically our biggest problem, that we are working very much alone. We talk with each other at different meetings, but do seldomly look at each other’s farm, especially if you’re not a member of any erfa-group” (Farmer 10).

The same farmer did also emphasise the value of discussing with colleagues:

"It has been fine (to get new inputs from other farmers). The discussion between farmers is really what gives the most. Go to meetings and listen to advisors is good, but the breeders that are working with the animals every day are normally just as skilled as the advisors” (Farmer 10).

Structure

The structural way of working with different themes and problems, and one person leading the process, was emphasised as one of the main positive experiences with the stable schools. The farmers found it useful to have someone “from outside” to lead the group and keep them on track. This helped them to focus on solving the host farmer’s problems:

"The problem with the erfa-groups is that when we begin to talk about something it is difficult to stop. The result is that we never manage to go through everything that we planned to do at the meetings. This is because there is always something that is more interesting to talk about than others. In the stable school, the discussion is more controlled” (Farmer 10).
Having an agenda for the meeting was seen as important. Prior to every stable school, the host farmer should choose two problem areas he/she wanted to work with and one success story to tell the other participants in the group. This was seen as a useful way to be forced to go through their own routines, as expressed by Farmer 7:

“The question about a success and a problem makes you think about your daily routines. Instead of it’s something that you just do”.

Especially to have something put down in writing after the meetings was seen important. Farmers saw it as positive to write what the host farmer had chosen to work with inspired by the different suggestions from the group. This committed the farmer more, as expressed by Farmer 3:

“(Writing down what you would like to work with in the future is good) because you will then be confronted with it, and you will actually do something, instead of just talking. That is also nice.”

Other farmers did not necessarily see it as important to choose specific problems to work with per farm, but saw the general discussion of possible solutions to a specific problem valuable, and also a value to have it put down in writing in the minutes from the meetings.

**External inputs from WelFur**

It was mentioned that information from the WelFur-assessment of the farms was interesting to bring into the group discussion, and there could have been further discussions about these results in the group. The presentation of the results as benchmarking between farms was appreciated, especially because they could see how their animals were scored compared to their colleagues. Benchmarking was also seen as a possible tool to motivate farmers to talk about their problems related to WelFur. However, none of the farmers mentioned WelFur as a source of information for choosing what to work with in the stable school.

**Output**

The usefulness from taking part in the stable schools differed between the farmers. In general, the farmers found the whole process very useful and expressed that they had received new inputs to bring back to their farm, as mentioned by farmer 6:

"My expectation (to stable schools) was to get something useful to bring back and implement on the farm. And I think I have received that from nearly every meeting.”
It was mentioned that farmers who were beginners within mink production would probably have the highest output from stable schools compared with farmers with many years of experience. For the most experienced farmers a good discussion, smaller changes or a confirmation that own production practice was ok was enough:

"Yes, because you are talking some things through. Often that’s the only thing that is necessary, to think through why you do the things the way you do, or maybe there is an idea to do it differently" (Farmer 10).

Negative experiences

One main negative experience with the stable school seemed to be that the same problems were discussed several times without any new aspects or inputs to the problem. Several farmers expressed that it was difficult to find something new to talk about at the meetings, and especially the ones who were going to have the last meetings.

"(Before the last meeting) we had been around all the different themes or problems there could be within animal welfare.

.... There are many of same things and housing conditions on all farms, and the equipment is arranged in the same way. There is not so much variation. And there were mainly closed sheds on all farms" (Farmer 4).

The overall goal of “Animal welfare” was mentioned as a constraint, both because there were other themes that could have been interesting to discuss and because the farmers felt it was difficult to find something new to talk about. Sometimes, this also led the discussion on a side track. One of the farmers expressed irritation when farmers did not keep focus on the agenda at the meetings. This farmer saw it as important to be motivated for the general goal for the stable school to be included in a group.

"If this becomes more known by people, and something that runs for years, the people joining the school would be the ones that really would like to attend, and who know it from before. We were only six persons who did not really know what this was about. And even though we are adults, we were not especially good at being focused on the specific problems we were supposed to work with" (Farmer 5).
**Stable school contrary to erfa-groups**

The farmers saw the stable schools as a more structured way of working than the erfa-groups, like having one person lead the process and having a concrete agenda for the meeting with written minutes from the meeting. The erfa-groups were mentioned to be more general discussions around themes related to the season and not necessarily with meetings on all the farms in the group. The experiences about erfa-groups seemed to differ among farmers, from being mainly an informal discussion group to very active and professional groups.

**Finding themes/problems**

The themes or problems discussed in the group were diverse (Table 2). It was argued that all the themes were relevant to discuss in the stable school, and the farmers did not perceive any difficulties in discussing any of the themes:

“I think we would have managed to talk about any kind of themes” (Farmer 9).

Group housing was mentioned as a theme they discussed thoroughly.

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**Table 2. Problems discussed at stable schools in mink production**

<table>
<thead>
<tr>
<th>Host farmers’ problems</th>
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<tr>
<td>Injuries and mortality in group housing</td>
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<tr>
<td>&quot;Sticky kit&quot; syndrome</td>
</tr>
<tr>
<td>“Fatty liver disease” (hepatic lipidosis)</td>
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<tr>
<td>Teeth abscess</td>
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<tr>
<td>Sterile males</td>
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<tr>
<td>Access to straw in the end of the nursing period</td>
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<tr>
<td>Legally weaning of mink kits</td>
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<td>Metritis</td>
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<td>Injuries due to saliva licking in the nursing period in Pearl</td>
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<tr>
<td>Fur chewing</td>
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<tr>
<td>Control with the females’ body condition during winter time</td>
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<tr>
<td>Water cysts on several animals in the autumn</td>
</tr>
</tbody>
</table>
One farmer indicated that some themes might be easier to work with in a stable school than others. If there are many different ideas and solutions to a problem it might be difficult to see what might work on his/her own farm:

"It is just that when talking about sticky kits there are so many different kinds of good ideas. Climbing cages are different, there are not so many ways to do it” (Farmer 2).

Several of the farmers found it difficult to find problems to work with when planning their stable school on their farm, because the problems the farmer might had seen as important in the actual period or for his/her own farm had already been discussed. It was easier for the first host farmers, as expressed by Farmer 2:

“Since I was the first one, I took the ones that existed (short laughter). Well, it was much the same problems. The success story differed, but the problems they were a little bit… I felt it was easy, but I can imagine that it was difficult not choosing the same problems at the next meetings.”

**Seasonal production**

Mink farmers are used to plan ahead and think about the forthcoming periods. One farmer expressed that it is always more interesting to talk about upcoming problems than something that has just passed:

“Of course it feels better to discuss something that will come than something that has been. It will always be like that. Otherwise, there is a whole year until next time” (Farmer 7).

On the other hand, the farmers expressed that they know the production cycles, and what problems there might come in the different periods and could therefore easily discuss problems all year round:

"There is only this single cycle throughout the year. Therefore, we have more or less the same problems at the same time” (Farmer 4).

"Well, I don’t think so. They are very fixed, we nearly know before the period begins that we will have the problems” (Farmer 5).
3.3. Changes made during the process

The third main topic is “Changes during process”. Here we saw two themes; “Changes that were implemented” and “Changes not implemented”, see Table 1.

**Changes implemented**

The farmers mentioned five areas where they had implemented changes as a result of the stable school. The changes were not necessarily related to the problems they had chosen for their own stable school meeting.

1. Changes concerning injuries caused by aggressive encounters between mink in the growth period (phase 3): Several farmers introduced wind breakers in the mink’s entrance of the nest box in their climbing cages (turned horizontal), making the animals more protected from the other animals when entering the nest box. An extra shelf was inserted in climbing cages, typically closed, bended shelves hanging from the wire mesh between the lower and upper cage in continuation of the feeding place. Other initiatives were early weaning of kits that were going to be housed in group housing systems, putting only litter mates in group housing and plastic tubes for the animals for enrichment.

2. Changes concerning injuries caused by aggressive encounters between mink in the nursing period (phase 2): Briquettes of straw were given as enrichment for the kits. Additional water for the kits was provided, using a water drinker dispenser for rabbits. Paper under the false floor (provided prior to whelping and during early lactation) was provided so that the kits could be on the floor just outside the nest box.

3. Changes concerning fatty liver disease (Hepatic lipidosis) in the autumn (phase 3): Reduced the feeding level from September.

4. Changes concerning sterile males: More focus on management to control the body condition and test the males’ testicles during autumn and winter.

5. Changes in general: Focus on body condition and being more aware of the animals’ welfare.

**Changes not being implemented – and why not**

Reasons for not implementing changes after the stable school on the mink farm were mainly of practical reasons, due to the legislation or due to being an experienced farmer:
1. Practical reasons. One farmer wanted to have straw on top of the cage to give access to straw in late lactation. This was difficult due to the manure system on the farm. The same farmer would like to have tried to use horizontal wind breakers but had another kind of wind breakers that could not be turned horizontally. Another farmer could not use wind breakers because he/she also had male mink in group housing, and they were too big. A third farmer would have tried to keep only females in group housing, but had too many males.

2. Due to legislation. There was a general view among the farmers that the main reason for injuries in late lactation was late weaning, and that this was due to the legislation saying that mink kits shall not be weaned before eight weeks of age (Anonymous, 2006; Council of Europe, 1999).

3. Experienced farmers. Farmers with a long experience within mink production explained that they had done a lot of changes and improvements over the years, and that now there were mainly small changes or ideas they would pick up from other farmers.

3.4. Suggestions for how to improve the stable schools

Four issues were raised especially as suggestions for improvements of the stable schools: “Season is important”, “Not necessarily farm-specific”, “Keep the group focused” and “Replace a veterinary visit” (Table 1).

**Season is important**

It was suggested to work with problems that are relevant for the actual period for the stable school meeting. Several farmers argued that it would be easier to talk about forthcoming problems and problems you are in at the time of the stable school meeting, than problems that are not relevant until several months later:

> “But, it is often when the problems are present you talk things through, and that is fine I think” (Farmer 2).

**Not necessarily farm-specific**

It was suggested to work with general issues instead of problems related to the host farmer within the overall aim of improving animal welfare. The group could discuss general issues that are related to the respective periods, and problems related to the host farmer could be secondary issues at the meeting. One farmer suggested meetings across regions with farmers from south, middle and north of Jutland in the same group. It would then be appropriate with only two or three meetings per year, related to the seasons:
“Well, it would have been different if you met with someone you did not know from before. I guess that would have given more. One possibility could be to make groups across different parts of the country. We have developed some quite similar routines in our area, which differ widely from the way they do things in north and south” (Farmer 10).

**Keep the group focused**

The importance of full information about the structure and aim of the stable school before starting up was emphasised. This to be sure that the farmers are motivated and have knowledge about what they can expect from each other. It was seen as necessary with a person leading the meetings very strictly to ensure the focus in the group. Furthermore, it was suggested that in future stable schools, the host farmer could lead the meetings, having an agenda for the meeting. The stable schools could also be on other issues than animal welfare and include discussions about statistics from the “farm cockpit” (management information about skin quality and production per farm registered at Kopenhagen Fur) or from the welfare assessment WelFur.

**Replace a veterinary visit**

It was suggested that one of the veterinary visits in the mandatory health advisory service could be replaced with a stable school meeting. One problem might be the length of the meeting which would be more than two hours, compared with the veterinary visit that normally takes only one hour.

“We have already four visits per year by the veterinarian. If the veterinarian would do one of the visits like such a visit (stable school)... But, it will easily last more than one hour. The four times the veterinarian is at the farm, it is normally only for one hour” (Farmer 3).

4. **Discussion**

The results show that the farmers are very positive towards the stable school’s structural way of working, and a discussion of problems not relevant to the actual phase of production was not a problem, although, they did find it difficult to come up with new things to work with at the last meetings. The farmers might not necessarily have changed anything special in management relating to animal welfare but stressed the importance of discussing with colleagues and visiting other farms.
The farmers emphasised that all themes could be discussed and worked with in the stable school. The changes made or planned to be made were mainly relatively simple generic solutions related to complex welfare challenges like injuries in the nursing period and among growing juveniles. Due to the farm-specific approach of stable schools this was contrary to the more farm-specific solutions we expected. The farmers received just as much input from the other meetings in the stable school as from their own, indicating that problems are less farm-specific in very uniform production systems. Therefore, it might be beneficial to adjust the stable school procedure in uniform systems e.g. to discuss more common problems and how solutions may be applied locally. The farmers seem to perceive the stable school as a useful tool to work with animal welfare related questions and management, with some adjustment related to uniform systems and to meet the farmers’ interest related to seasons.

The farmers’ main motivations for joining the project were meeting and discussing with other colleagues. This was also something they appreciated during the stable school. Meeting and discussing with other farmers has also been reported as being the farmers’ main positive experiences with other stable schools (Hektoen and Sogstad, 2011; March et al., 2014). One of the farmers expressed that farmers are very much alone on their own farm. Earlier studies have shown that loneliness has been one of the main challenges among livestock farmers (Jeppesen and Just, 2006), but this does not necessarily seem to be the case anymore (Andrade, 2012). Today, several mink farmers have employees and are therefore not working alone on the farm. Still, many of the employees are from Eastern Europe, and the communication between the farm workers is therefore often in English. Hence, professional discussions might be limited, explaining the need for meetings with other colleagues.

Other motivations for joining the project were curiosity and the structural way of working, compared with erfa-groups. The concept of stable school was something new and gave an opportunity to see other farms and meet new people. The farmers especially saw the benefit of having one person lead the discussion, helping the group to focus on the actual problem or themes that were on the agenda for the meeting, involving all participants. The role of the facilitator is one of the main differences between stable schools and erfa-groups, putting aside the role as an expert to ensure common learning among the farmers (Lisborg et al., 2005; Vaarst, 2007). The farmers are equal and not dominated by a professional (Bourdieu, 1990). Still, external inputs were seen as desirable, but the form of this was production-related farm data or results from the welfare assessment WelFur.
In the present study, one of the main challenges with the stable school was that the farmers were not familiar with stable schools and did not really know what they agreed upon when saying yes to join this concept. The focus on having motivated farmers to join the schools was mentioned as important in future improvement of stable schools. A common goal makes it interesting to work with farms that are different from one’s own and is of crucial importance for a stable school (Vaarst et al., 2007; Vaarst and Fisker, 2013). The goal in the present study might have been too vague, working more as a theme than a goal they wanted to reach. Lack of motivation for the common goal could explain why some of the farmers in this study did not find anything to improve on their farm.

The farmers did not mention the importance of ownership during the interview. Farmer’s ownership to the process is said to be crucial for a successful welfare planning (Ivemeyer et al., 2014; Nicholas et al., 2008) and fundamental in stable schools, just like the common goal (Vaarst et al., 2007). In the present study, the farmers did not seem to see the host farmer’s ownership of the stable school meeting as important. One reason for this might be that the housing conditions for mink are very similar across farms, and the problems at each farm are not necessarily farm-specific. The different advises to a host farmer might therefore be easy to implement on other farms. If this is the situation, general meetings on one of the farms could be just as good as the farm-specific stable schools. However, it might still be useful to visit many different farms to see different solutions in practise. One reason for not implementing some of the generic solutions was mentioned to be of practical reason due to different equipment or animals. Despite the high similarity between farms, compared to other animal production systems, farm-specific solutions are still needed due to small differences. This indicates that another reason for not seeing farmer ownership as important might be that the farmers did not go enough into details about the host farmer’s problems and therefore did not see the very specific problem related to the host farm that would warrant a specific local solution. This has also been mentioned as a challenge in stable schools in dairy production (Søgaard, 2013). Therefore, the different advises from the meetings might be too general and not related to the specific farm. In such situation, the facilitator could try to help the farmers in the group with additional questions to highlight the farm-specific challenges.

The low importance of specific situations on the different farms might be related to the farmers’ negative experience with difficulty in finding new aspects or themes to discuss at the last visits. All the main problems had been discussed, and the farmers had received contributions to their problems from the visits on other farms. This also implies that the different advice for the different host farms was either very general or relevant for the other farms due to similar production systems. This might also imply that the farms did not have any serious welfare problems on their farms. Several of
the farmers were experienced farmers who had tried a lot of different solutions before. These farmers also mentioned that it was good just to be confirmed in the fact that their own practice was good enough, which also has been an experience in other stable schools (Nielsen, 2009a). The farmers saw stable schools as especially useful for new or young farmers with minor experiences in mink farming, but they were all happy joining the school.

The farmers suggested that future stable schools could be related to the relevant problems in the actual period for the different stable school meetings. This is similar to many erfa-groups but could be made farm-specific by letting the farmers at the first meeting choose which period they want to work with. The annual cycle of the production gives the possibility to have meetings and implement preventive strategies before the potential problems occur. It was also suggested to have more general themes at the meetings with the farm-specific problems as a secondary issue. The meetings then would become very similar to erfa-groups, but could still include the structure of having a person leading the discussion and writing minutes. The concept of stable schools is built upon the principle of common learning and the farmer’s ownership of the process (Vaarst, 2007). It is, therefore, important to have a common goal to work towards, also when using season related themes, which all the participants are interested in and feel responsibility for working towards.

In this study, farmers had implemented changes in their management or with the animal surroundings as a result of the stable school. Other studies have pointed out that the changes were made as a result of being convinced by other farmers (Vaarst et al., 2007). Reasons for not doing any changes during the year with stable schools in the present study were mentioned to be due to practical constraints and limitations seen as connected to legislation. Mentioning the legislation as a limitation shows that the farmers disagree with some of the regulations and it can create a resistance not seeing other possible solutions. Another study has shown that Danish livestock farmers can have different interpretations of the legislation of animal welfare than the authorities, and this is based on different values on animal welfare (Anneberg et al., 2012).

The focus area chosen by the farmers was mainly related to health, which is in line with other studies (Ivemeyer et al., 2012; March et al., 2014). This might reflect a general focus on health regarding animal welfare (Vanhonacker et al., 2008), but might also reflect the general focus from the authorities with extra campaigns by the Danish veterinary and food administrations (DVFA) Veterinary Task Force (Videncenter for dyrevelfærd 2014).

A suggestion for future stable schools was to implement the schools as one of the obligatory veterinary visits in a health advisory service. One risk of implementing stable schools as a
mandatory service for mink farmers is non-motivated farmers joining the schools only because alternatives to stable schools are less attractive. This is claimed by Vaarst and Fisker (2013), and it also emphasises a fundamental mismatch between stable schools being “farmer-driven and farmer-owned group approach” and the aim of a legislation of mandatory health advisory service as a way of “fulfilling the legislation and ensuring minimum animal welfare and health standards” (Vaarst & Fisker 2013:123).

Discussion of method
The farmers in the present study participated in another project on welfare assessment of mink with the assessment system WelFur-Mink (Mononen et al., 2012). The farmers were provided with information about their animals’ welfare assessed in each of the three phases of production. This can be seen as external input to the group, which is emphasised as positive in animal health and welfare planning (Nicholas et al., 2008). On the other hand, the farmers might have felt obliged to work with issues raised from the assessment, reducing the farmers’ ownership of the process. This does not seem to be the case as WelFur results were not mentioned by the farmers when asked about what problems they wanted to work with in the stable school. It was mentioned that discussions about statistics from WelFur could be good to implement in the stable schools, though. This could be done independently from the farmers’ decisions of what to implement on their farms to ensure the farmers’ ownership and motivation for intervention.

The first author was both the facilitator in the present study’s stable schools and the one doing the interview with the farmers. Therefore, questions about the role of the facilitator were asked quite late in the interview, not leading their thoughts to the interviewer as the facilitator person. The farmers answered very vague on the question, and the answers were therefore not included in the analysis of the interviews. Nevertheless, the farmers’ emphasis on a person leading the meetings did not seem to be affected on the interviewer being the facilitator as such, but was more a general reflection that came up during the interview.

Since an important principle of stable schools is farmer ownership of the process, changes in management related to animal welfare will be based on the farmer’s personal understanding of animal welfare, which probably will be related to good health (Vanhonacker et al., 2008). Different understanding of animal welfare within the group might help farmers to respond to and cope with the perception of animal welfare held by lay people.
5. **Conclusion and further perspectives**

Based on the farmers’ perception of stable schools in mink production, the concept seems to be useful to improve management in strictly synchronised production systems. Motivation for the common goal is important, and participation in stable schools should therefore be voluntary. General welfare improvements as a common goal might be too vague to motivate farmers and could be specified. The present study shows that mink farmers appreciate the stable schools compared to erfa-groups, due to the structural way of working by having an external person systematically leading the meetings. The strictly seasonal production does not seem to be a problem, but the farmers would prefer to work with problems related to the actual phase of production at the different meetings. To ensure a farmer’s ownership of the process, the farmers could choose which problems they would like to work with individually in the beginning of the stable school and plan further meetings from relevant problems throughout the year.

The effectiveness of a stable school as a tool to improve mink welfare depends very much on the farmers’ definition of animal welfare. The different views within the group will, to some extent, give a broader approach to welfare. External input to the group with result from welfare assessment of the farm compared with other farms might also motivate farmers to improve issues that are not necessarily related to their own definition of welfare.

**Acknowledgment**

This study was financed by Aarhus University and European Fur Breeders Association. The authors would like to thank the participating farmers for their involvement, hospitality and sharing of experiences with the stable schools, and the two veterinarians for helping with selecting farmers for the study.

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5 General discussion

The overall aim of this PhD study was to evaluate the welfare assessment protocol WelFur, developed for the strictly synchronized mink production system and to evaluate stable schools as a system that utilises the knowledge and experiences among farmers, in order to improve animal welfare in these systems. Due to the strictly synchronized production system, all the animals on a farm might be in risk of the same welfare problems at the same time, and the possible changes in the classification of welfare due to time within and between the phases of the production were evaluated. Firstly, the classifications of welfare in the nursing period were studied to see if the classification changes during the eight week assessment period. Secondly, an estimated classification of welfare in each of the three phases of the production was compared with the overall annual WelFur classification to see if it is possible to reduce the number of visits needed to assess welfare. Finally, stable schools were tested on mink farms to see if stable schools are a potential tool to encourage farmers to implement changes in management to improve their animals’ welfare.

5.1 Hypothesis I (Nursing period, Paper I)

The first study focussed at changes in the value of the different WelFur scores due to four main welfare measures, which were expected to change in score along with the assessment day post-partum in the nursing period. The measures were “Mink dam’s body condition”, “Frequency of dirty nests”, “Frequency of injuries” and “Diarrhoea”. As expected, the results of the study showed that the four measures changed with day post-partum. These changes resulted in a change in the score value of the related criteria “Absence of prolonged hunger”, “Comfort around resting”, “Absence of injuries” and “Absence of disease”, but not in the estimated overall classification of the farms. Estimation of WelFur scores per principle did also indicate a change with date of assessment. The hypothesis:

“In the nursing period, the prevalence of four animal-based measures changes so much with the date of the assessment, that it influences the WelFur scores at criteria level, but not at higher levels”

was therefore partially accepted due to changes at the principle level but not in the overall classification. The study shows that the WelFur calculations of the respective farms in the nursing period were robust and independent of changes in the conditions during the observation period. However, some of the principle score values were close to the borderline for a higher or lower classification and changes in the overall WelFur classification could occur if these measures had changed to a lower or higher score. This can be demonstrated by adding the 5 % indifference
threshold to the principle scores in Figure 4 in Paper I as it is done in Welfare Quality® (Blokhuis et al., 2013:161), in order to account for uncertainty of the assessment. The classification of the farms in the beginning of the nursing period will then be higher (“Best current practise”) than in the end of the period (“Good current practise”). If the same principle scores were reduced by only two percentage points, two of the farms would get a lower classification (“Acceptable current practise”) at their last visit compared with the earlier visits (“Good current practise”). This is in line with results from Kirchner et al. (2014b) who have tested the consistency over time of single measures and aggregated Welfare Quality® scores in welfare assessment of beef bulls, comparing data from three visits (month 0, 1 and 7) on 63 beef farms. They pointed out that changes in scores were especially apparent when values were around a given threshold.

The study shows that the score values of criteria based on several measurements are not significantly affected by single measurement scores. The weighing of score values is based on expert opinions and reflects the importance of the single measurement compared with the other measurements. Still, measures like “Body condition score”, which is the only measurement within the criteria “Absence of prolonged hunger”, which again is one of two criteria in the principle of “Good feeding”, will have a higher influence on the overall score than measures like “Mortality”, which is one of four measurements within the criteria “Absence of disease”.

5.2 **Hypothesis II (Simplification of the protocol, Paper II)**

The second study looked at mink welfare assessed within the three assessment periods (i.e. within the three phases of mink production) according to the WelFur-Mink protocol. The aim was to investigate whether a welfare assessment in one period can reflect the overall assessment of the welfare of a full annual production of a mink farm. The study showed that the overall WelFur classification in the three different assessment periods differed. The hypothesis:

“The overall annual welfare classification of a mink farm in the welfare assessment system, WelFur, can be based on assessment in only one of the three annual production phases”

was therefore rejected. The study showed high correlation between the overall annual WelFur scores and the estimated score values for the WelFur principles in assessment period 2 and 3. The results therefore imply that assessment period 2 and 3 provide enough information to calculate the overall annual welfare score, and that it might be possible to exclude the assessment in period 1. The need for more than one assessment is in line with Kirchner et al. (2014b), who stated that
General discussion

reliable on-farm welfare assessments should be based on repeated assessments. They found that the repeatability over six months was not sufficient for reliable Welfare Quality® classification of beef bull farms regarding welfare. Therefore, they suggested generating rolling averages or using repeated assessments to verify assessments that would cause reclassification of farms.

One argument for testing hypothesis II was that management has shown to be very important for farm animals’ welfare (Sandoe et al., 1997; Hemsworth and Coleman, 2010), which could lead to a similar welfare status in the different phases of mink production, as the manager on mink farms usually is the same throughout the year. However, the study showed that welfare changes between periods due to the complex effect of management on welfare. The management in one period might influence the welfare in another period, like feeding strategy for optimal reproduction in phase 1 of the production can result in a high litter size and thereby an increased risk of very thin dams in phase 2 (Hansen and Berg, 1998; Hansen, 1999). The specific interest of the manager might also increase the effort in one phase of the production compared with another.

The study in Paper II showed that the low score value of the measurement BCS in assessment period 2 has a high influence on the overall classification due to being the only measurement in the criterion “Absence of prolonged hunger”, which is one of only two criteria in the principle of “Good feeding”. The other principles consist of three or four criteria with several measurements, and the single measurements do not seem to have the same influence on the overall classification. This shows that combination of two or more measures into one criterion may, to some extent, smooth the differences in score values both between the measures and between the values of measures in the three assessment periods, and is in line with the results in Paper I and is also discussed in Kirchner et al. (2014b). In most cases, the period with the lowest score will also have the highest influence on the full score value due to the method of aggregation of sub scores as described in chapter 3.3.

The study in Paper II further implies the possibility of reducing the number of measurements in the different periods due to correlations between the full annual WelFur score and several criteria scores related to the different principles. Reducing the number of animal-based measurements in the different assessment periods would reduce the time needed for assessment per farm and make the assessment more feasible to implement in practice. A reduction of the assessment procedure, by reducing the number of assessments or the number of measurements assessed per period, is especially desirable in certification of farms. When using the result for advice and on-farm welfare planning, the whole unreduced assessment protocol might be relevant.
5.3 Hypothesis III (Stable schools, Paper III)

In the third study, stable schools were investigated as a tool to encourage farmers to improve animal welfare through farm management, and the aim was to explore the farmers’ perception of stable schools. The study was conducted as a qualitative study with the research question: How do farmers perceive stable school as a tool to improve management for the benefit of mink welfare? The qualitative interview revealed several aspects of how stable schools can be used as a tool for improving farm management, and the hypothesis:

“It is possible, based on qualitative interviews, to explore how farmers perceive stable schools as a tool to improve farm management for the benefit of mink welfare” can be accepted.

The interviews showed that the farmers appreciated discussing with other colleagues and seeing each other’s farm, and they were very positive to have a facilitator leading the process in a structured way. This was mentioned as the main difference from the erfa-goups (discussion groups), which is also emphasised by Vaarst (2007). The social meeting with other colleagues and the discussion between farmers have also been appreciated by farmers in other stable schools (Hektoen and Sogstad, 2011; March et al., 2014).

Due to the seasonal production system, it was expected that the farmers would find the time lag between an issue being discussed and its actual relevance on the farm difficult to handle. On the other hand, it was also expected that they would see an advantage in the ample time, as it would give them time to find a solution and plan the implementation. The results showed that the farmers did not see seasonality as a problem, as they were used to think ahead to the next phase of the production. However, they did emphasise the benefit of discussing a problem when it was relevant, i.e. during or just before the period in which they experience the problem, due to more focus and interest among the farmers.

Farmers found it interesting to bring information from the WelFur assessment into the group and mentioned that the results could have been included more in the group discussion, and other kinds of statistics could also have been included (like information about skin quality, kits per dam etc.). The farmers in the stable schools did, however, not mention their farms’ WelFur results as a source for finding which problems to work with.

Some problems might have been more difficult to work with than others. This could be problems which reappear almost every year and are well discussed among farmers like different diseases. However, the farmers mentioned that all kinds of themes or problems could be beneficial to discuss
in the group. If no changes were planned or introduced as a result of the stable school, this was often due to practical reasons (type of equipment and their way of grouping animals), or because they saw the problems as a result of legislation (injuries in late lactation due to late weaning). Another reason could be because farmers were experienced and had done a lot of changes and improvements previously. They saw stable schools as especially useful for new farmers or farmers with low experience in mink farming. The practical reason for not doing any changes can indicate that the stable school did not go into the specific possibilities on the actual farm. However, the practical limitations mentioned were mainly related to solutions on problems discussed at other farms and did not fit to their own farming system. This implies that the actual solutions from the farmers were farm-specific, which is an important principle in stable schools (Vaarst et al., 2007).

The farmers did not mention anything about the importance of farmer ownership of the process, which has been emphasised in other studies (Ivemeyer et al., 2014) and is fundamental in stable schools (Vaarst et al., 2007). This could be because the problems at each farm were not necessarily farm-specific due to very similar housing conditions for mink across farms. It could also be that the farmers did not go enough into details about the host farmer’s problems and therefore did not see the very specific problems related to the host farm that would warrant a specific local solution.

5.4 Methodological considerations

Mixed motivations for joining the project

Paper III showed that a shared motivation for the common goal was found to be very important for a good discussion in the stable schools. There has been general focus on animal welfare in the European mink industry (EFBA, 2013), and in Denmark, there have been extra campaigns and unannounced welfare controls by the authorities to all Danish mink farms (Danish Centre for Animal Welfare, 2012; Videncenter for dyrevelfærd, 2014). The farmers’ interest in joining the present study might therefore have been affected by a need to focus on animal welfare, and not necessarily because they saw any significant welfare problem on their farm. A more specific overall goal to work towards might ensure motivated farmers. This could be a goal which is easy to measure, i.e. to see improvements on the farms like reduction of injuries and mortality.

The motivation for joining a stable school within animal welfare might have been lower than the motivation for joining the WelFur assessment study. The assessment of their animals’ welfare might have been easier to understand than stable schools, which was a new concept for the farmers. In order to increase the motivation for working towards a common goal, it could have been preferable
to have separated the stable school group from the WelFur group. On the other hand, I was interested in seeing whether the farmers used information from the WelFur assessment in the identification of problems to work with in the stable schools.

**Influence of stable schools on the WelFur assessment**

There might have been a bias in the study described in Paper II, as welfare might have improved from the first to last visits due to the stable school participation. Changes mentioned by the farmers were i.a. improvements of management routines or of the animals’ environment to reduce aggressive encounters between mink in the growth period. This was especially in relation to climbing cages. Changes related to feeding and fatty liver disease were also mentioned. Data from injuries and mortality on the ten farms included in the testing of stable schools are shown in Appendix 2. When comparing data from 2012 and 2013 there was no significant difference between the two years. The nine farms from 2011 would also adjust for the potential effect of stable schools, and the results from the 10 farms did not differ from the nine farms in welfare change from the first to the last visit. A difference between the two years could have been influenced by other factors not related to management, like feed composition or weather conditions. Other studies have shown that one year is too short to see any great improvements from changes in management (Ivemeyer et al., 2009; Ivemeyer et al., 2012). It is, therefore, not likely that the farmers’ participation in stable schools has influenced the results of the study in Paper II.

**Influence of the WelFur assessment on the stable schools**

The ten farms that were involved in both the second (Paper II) and the third study (Paper III) had a welfare assessment conducted on their farm and joined a stable school. The welfare assessment may have led to farmers having an increased focus on their animals’ welfare, and leading their focus on areas which came up from the results of the assessment into study three. This did not seem to be the case as none of the farmers used information from the WelFur assessment directly to identify the problems that they wanted to work with. They might have become more aware of the animals’ welfare, but the issue of the study was not to measure any welfare improvements during the year, but the farmers’ perception of stable schools. The farmers’ perception of stable schools as a tool to improve animal welfare could have been mixed with their experiences with the WelFur assessment in the second study. However, the questions and follow-up questions through the interview would reveal this.
The role of the interviewer

The first author of Paper III was both the facilitator in the study’s stable schools, the one doing the qualitative interviews and involved in the welfare assessment on the farms. This might have had an impact on the qualitative interviews. An advantage is that the farmers were familiar with the person doing the interview, making it easier to get a good connection with the interviewees, which is important for being able to go into the respondent’s views and personal experiences (Kvale and Brinkmann, 2009, p.128). Another advantage is that the interviewer knows the farmers from beforehand, which makes it easier to understand and interpret their answers. A disadvantage could be that the farmers would answer what he/she thinks the interviewer would like to hear. Therefore, answers about the role of the facilitator and discussions about what animal welfare is about were not included in the study. The farmers were not necessarily positive towards stable schools in the way it was conducted in the study and came up with several suggestions for improvements. The farmers did, therefore, not seem to be affected by the roles of the interviewer.

Generalisation of the Danish results

The farmers participating in the three studies in the present PhD study were all Danish mink farmers. The conditions examined in the mink’s nursing period are very general. The increased risk of very thin females is related to the biological functioning with the mobilisation of body reserves from four weeks of lactation (Hansen, 1999). The feeding management might differ between countries, but the biology of the female mink, and thereby the risk of very thin animals, will be the same. The risk of dirty nests is related to feeding on the lid of the nest boxes in order to ease the kits’ access to feed. Feeding on the nest box lid is mentioned in the Canadian code of practise (Finley et al., 2013) and is probably a normal practice in most countries. The risk of diarrhoea might differ between countries because of the difference in infectious agents, but the risk of ‘sticky kits’ early in lactation (before they start to eat solid feed at around four weeks of age (Clausen and Dietz, 2000; Englund et al., 2002)) and ‘normal’ diarrhoea after that will probably be the same across countries. The risk of injuries in late lactation is linked to aggression among the kits as the kits’ need for water increases, especially just before they start drinking from the watering system. This is highly dependent on management such as weaning age, feeding and water supply, but will probably be similar in the European countries, where weaning before eight weeks after parturition is not allowed according to common regulations (Council of Europe, 1999).

The welfare of mink in other countries might differ compared with the Danish farms, but the risk of change will probably be the same. One can therefore assume that the results of the study related to Paper I will be relevant under other farming conditions than Danish. The risk of change in overall
classification of farms due to date of assessment might increase if the welfare is generally lower or higher than the Danish farms, resulting in principle scores close to the borderlines for higher or lower classification (the principle score values required to get classified into the different categories are shown in Table 2 in Paper I and II).

When looking at mink welfare in the different phases of mink production, the welfare might differ between countries due to differences in weather conditions, feed, management and housing traditions etc. The WelFur classifications of farms in the study in Paper II were all “Good current practice”. There were significant variation in score values both between farms and assessment periods in the study, but large scale assessments will be needed in order to display the true variation between European farms, and thus how representative our sample was. The impact of weather conditions on the mink’s metabolism might lead to other welfare conditions in countries with higher temperatures during summer or lower winter temperatures compared to the Danish farms in the present PhD study. The risk of infectious diseases, especially Aleutian disease, might also differ between countries. Further studies are therefore needed to evaluate the relevance of the results related to Paper II.

There might be cultural differences between countries that influence farmers’ experience of stable schools. Farmers in Denmark are used to discuss and share experiences with each other in discussion groups, and many farmers are actively contributing in local arrangements and meetings related to Danish Fur Breeders’ Associations. Stable schools require openness and trust between farmers (Vaarst et al., 2007), and this might be difficult in countries with no or low tradition for collaboration between farmers. In some countries, there are no specialised advisory or veterinary services in mink production. In such countries, stable schools could be a very useful tool to spread knowledge among farmers and to help them improving their animals’ welfare.

5.5 Overall discussion

The three different studies in this PhD thesis represent different aspects of health and welfare planning procedures on mink farms. Key figures in animal health and welfare planning are 1) Assessment of health and welfare state, 2) Analysis of outcomes and feedback, report of results on the farm, 3) Farm-specific and targeted advice related to health and welfare issues and 4) Constant review and assessment (Vaarst et al., 2011; Tremetsberger and Winckler, 2015). The overall discussion is focused on how the results of the studies in this PhD thesis are relevant for welfare
assessment for certification of mink farms regarding animal welfare, and how the results can influence a health and welfare planning process on mink farms.

**Welfare assessment**

The WelFur assessment of mink farms ends up with a classification of farms regarding their animal welfare. The results of the study in Paper I show that there is a potential risk of changes in the WelFur classification of a mink farm within the nursing period (assessment period 2). This is important to take into account, especially in certification schemes, where the changes in scores might lead to a farm being certified or not. One option could be to limit the time window for the welfare assessment within the period. However, this would drastically limit the feasibility of the WelFur-Mink assessment system, as the need for assessors will increase compared with the other assessment periods.

One way to counteract the potential change in WelFur score within the assessment period could be to include a correction factor to level out the effect of date of assessment, especially regarding the dam’s body condition. Such a correction factor should, however, be proven correct for farms in general, which would not be easy. The increasing risk of a lower WelFur score towards the end of the assessment period might also be apparent in the other two assessment periods. Another option could, therefore, be to stratify the visits per farm in the relevant assessment periods, with one early visit in one period, one in the middle of another period and one at the end of a third period. If farms are assessed in only period 2 and 3, as suggested in Paper II, the farms visited early in assessment period 2 should be visited in the end of assessment period 3. However, this will depend on results from further studies of changes in welfare scores within assessment period 1 and 3.

Another alternative could be to exclude period 2 from the assessment. Paper II does, however, show that the assessment in period 2 is important for an overall annual classification of farms regarding welfare and should therefore not be excluded. On the other hand; this study indicates that assessment period 1 could be excluded with only limited loss of information. Paper II also discussed the possibility of reducing the amount of measures assessed in the different periods. Both body condition score and the criterion “comfort around resting”, which includes information about dirty nests, seem to be important to the assessment period 2, while the measurements related to the criteria “Absence of disease” and “Good human animal relationship/positive emotional state”, which i.a. include the temperament test, might be excluded as long as they are included in assessment period 3. The body condition score and the score for the criterion “comfort around resting” were both significantly affected by the average age of the kits within assessment period 2.
General discussion

A reduction in the number of measurements in this period would make it faster to assess farms and reduce the number of assessors needed. This might also enable a reduced time window.

A disadvantage of a simplification of the WelFur assessment procedure is that the farmers will be provided with less information from the assessment to use in future welfare planning on their farm, even though only measurements with low information value in terms of the welfare status of the mink would be omitted. As the effectiveness of a science-based health and welfare planning depends on the implementation in practice, the procedures need to be developed in close dialogue and collaboration with user groups (Jorgensen et al., 2007; Pompe and Hopster 2014). Therefore, farmers and advisors should be involved in an eventual discussion of which measurements that could be omitted and which are important to keep in the assessment for on-farm health and welfare planning. Involving farmers in further improvements of WelFur might, therefore, increase the practical usefulness of the assessment for farmers and ease the implementation of the assessment system. The results of the study related to Paper II showed that assessment period 1 had low influence on the overall annual score and could possibly be excluded from the WelFur assessment for classification of farms. An assessment in period 1, with the most influential measurements, could, however, still be relevant in on-farm health and welfare planning.

Analysis of outcome and feedback

It is important that the results of the welfare assessment are analyzed and presented to the farmer in a way which is useful for the practical situation of the farmer and in line with the way farmers carry out their work (Jorgensen et al., 2007). Including a discussion of the WelFur results related to the different farms in a stable school, as suggested in Paper III, will make the feedback practically relevant and enable the farmers to set the results into a practical context. The host farmer should still choose for him/herself what to work with to ensure the farmer ownership of the process (Nicholas et al., 2008). The farmers’ awareness of different animal health and welfare issues have shown to be underestimated (e.g. lameness in dairy cattle as referred by Tremetsberger and Winckler (2015)) or unequally perceived by different farmers. Comparing and discussing the results from the WelFur assessments on the different farms in a stable school can influence how the farmers perceive the different animal health and welfare issues and might result in a common understanding in the group. Benchmarking is one way of presenting the data to the farmers, showing the proportions of their problems compared with colleagues (Huxley et al., 2004). Benchmarking of farms, by comparing the results from the different farms, might motivate the discussion of the WelFur results in the stable schools and has been shown to be appreciated by farmers (Leeb et al., 2011).
General discussion

Farm-specific and targeted advice
An important principle for a successful health and welfare planning is that the process is farm-specific and driven by the farmer (Whay and Main, 2010; Vaarst et al., 2011), especially the steps of setting targets and choosing what to work with and implement on the farm. The results of the study in Paper III show that mink farmers appreciate the structural way of working in a stable school with having an external person facilitating and leading the meetings, but did not focus on the farmer ownership of the process. Several management improvements were suggested, but not necessarily implemented on the farms. The result of the study implies that with some adjustment of the stable school procedure, e.g. according to the seasonality of the production, stable schools could be a system which utilizes the knowledge and experiences among farmers to improve the animal welfare in mink production. Further development of stable schools for mink farmers should focus on ensuring farmer ownership of the process.

Constant review and assessment
In a planning process it is important that the farmer ensures a constant evaluation of the welfare situation and implements new improvements when needed. The results of the study in Paper III show that the farmers found it difficult to find new problems to work with at the last meetings. After one year of stable school meetings, it would probably be beneficial to join another stable school with other farmers or change the overall aim to work towards in the group. This might be dependent on the motivation for the overall aim, or how farm specific the problems are, as discussed in chapter 5.3. Stable school is normally a one-year process with a second follow-up meeting to evaluate the planning and implementation process after the first meeting (Vaarst et al., 2007). In seasonal productions, the time lag between the discussion and planning of improvements, until the changes can be implemented, might be up to a year (Møller, 1999). Therefore, a follow-up meeting within a one-year stable school might not be relevant in seasonal production systems. A possibility could be to have a one-year stable school and a follow-up meeting one year later, or after every main phase of the production to discuss results of the implemented changes and to make new plans.
6 Conclusions

The findings of this PhD study show that there are a number of possibilities to reduce the assessment procedure WelFur-Mink without jeopardising the validity of the assessment of mink welfare on farms, taking the potential risk of change in score values within the nursing period into account. On-farm welfare assessment in all three phases of mink production is time consuming and expensive. A simplification of the WelFur assessment procedure would make the system more feasible to implement in large scale across different countries due to the reduction of time and effort in conducting the assessment, and thus in number of assessors needed.

A simplification of the WelFur-Mink procedure should not reduce the utility of the system for advisory purposes and on-farm health and welfare planning. The measurements which are necessary to assess might, therefore, differ between phases, depending on the influence on the welfare in the actual period and on the purpose of the assessment.

The findings show that stable schools can be a useful tool that utilises the knowledge and experiences among mink farmers to improve animal welfare on mink farms, and results from WelFur assessment might be useful information for the group. Some adjustments seem to be necessary to meet the seasonal challenges in the production, with the farm-specific problems being related to the relevant season of the meetings. The uniform production system at mink farms seems to gives special challenges in how to work with the different subjects to ensure farmer ownership of the process.

This PhD study shows that assessment of animal welfare and welfare planning in a strictly synchronized production system needs to take the different phases of the production into account.
7 Perspectives and future research

Motivation for animal welfare improvements among mink farmers, and a reliable and efficient system for assessing mink welfare, should lead to a continuous improvement of the mink’s welfare on farms. The present PhD study has contributed with knowledge on how the reliability of assessment in the nursing period is challenged by date of assessment and ways to handle this and on how to make the WelFur assessment of mink more efficient. The study has also evaluated stable schools as a tool in mink production and discussed the possibility of using stable schools to implement changes based on the welfare assessments on farms.

A simplification of the WelFur procedure for classification of farms will ease the implementation of WelFur-Mink for certification of farms in the European mink industry. The calculation of WelFur scores and the classification of farms are dependent on information from all the measurements in the three different assessment periods. Therefore, excluding a full assessment period, or single measurements from assessment in some periods, will lead to a need for revision of the aggregation into the different WelFur scores and the overall classification of farms.

An assessment of farms regarding animal welfare is a way to demonstrate the actual level of animal welfare in the industry, to the industry itself, the public, consumers, politicians and to governments using a transparent methodology endorsed by the European commission. A classification of farms regarding animal welfare can be implemented in a certification of fur products, for retailers, the fashion industry and end users. This is likely to be profitable for the fur industry and makes it possible to differentiate the prices, with higher prices for mink pelts from farms with higher welfare classification. All of this will probably motivate farmers to work for a higher classification of their farm. Results from WelFur assessments of farms in Europe will reveal general welfare problems and challenges that are important to address in science, or in focused advisory services for farmers. Results from WelFur assessments can also be useful information in development and evaluation of legislation.

Mink farmers can use information from WelFur assessments to identify challenges regarding welfare on their farm and discuss the results and possible management improvements with their veterinarian, other advisors, and colleagues in discussion groups or in stable schools. Advisors and veterinarians can use information from the WelFur assessment in their discussion with the farmers to get an impression of the overall welfare situation on the farms. In a number of European countries, health advisory agreements between mink farmers and a veterinarian are mandatory by legislation or by breeder association agreements, providing a strong framework for implementation.
of WelFur data into farm management. A successful implementation of WelFur-Mink, both for certification and for on-farm welfare planning purposes, requires accept among farmers and other stakeholders in the mink industry. Therefore, transparency of the assessment system is important, and involvement of farmers and stakeholders in different countries in further development and implementation of the system would be beneficial.

The present PhD study shows that stable schools adjusted to the seasonal structure of the production system might be useful for farmers as a tool to implement changes in management to improve the animal welfare on their farms. Welfare challenges identified by WelFur assessment can be discussed further in the stable school. Benefits of stable schools, compared with other discussion groups, are the farmer driven and structured process, without any other experts than the farmers, and an external person leading the meetings. Stable schools will especially be useful for new or less experienced mink farmers, learning from and discussing different problems with more experienced farmers. Advisors and veterinarians may be involved in stable schools as facilitators, as long as they do not work as experts in the groups. The written notes from the stable school meetings could also be sent to the veterinarian connected to the farm to inform about the discussions and the health and welfare planning process.

**Future research**

The potential change in WelFur classification in the nursing period should be further evaluated and compared with similar studies in the other assessment periods. If the risk of a lower WelFur score increases towards the end of the assessment period in all three periods, stratifying the visits between periods with one early, one in the middle and one late visit could be a simple way to handle the reliability regarding date of assessment. This could be further investigated with conducting three visits to the same farms in the three different assessment periods, comparing the score values from different combinations of the visits. The possibility for developing a correction factor should also be evaluated. This would require a larger study sample and more frequent assessments of e.g. the dam’s body condition in the nursing period than in the present study in Paper I. Different countries should be included due to potential differences between countries, e.g. feeding strategies or weather conditions. Specific risk factors related to very thin dams should be evaluated in order to be included in the development of the correction factor. A correction factor should be proved valid across farms and countries before implementation, and therefore stratifying the farm visits in first, middle and last trimester of the assessment periods seems the best potential choice at present.
In order to evaluate the effect of different weather conditions and management practices in other countries in relation to the results of this PhD study, information from WelFur assessments on farms from different countries should be analysed. Further research should include a random sample of farms from different countries, which should be assessed, according to the WelFur-Mink protocol in all three phases of the production. Estimated scores per period could be compared with an overall annual WelFur score as in the study in Paper II in order to evaluate the possibility of simplification of the procedure across countries. The WelFur assessment procedure is planned to be tested on farms from 10 different European countries in 2015-2016 (European Fur Information Center, 2014). The purpose is to test and calibrate the system across various climates and farming conditions. Data from these assessments can give an impression about the various differences and challenges in the different countries.

Changes in welfare within the nursing period, as shown in Paper I, might imply that the results from an official control of compliance with animal welfare legislations are also dependent on the time of visit within the period. The results of the study in Paper II show that one visit cannot be generalized to the overall welfare of a farm, which might also be the case in an official control. Paper II further suggests that the overall welfare on a farm can be assessed from assessment period 2 and 3, indicating that the general risk of welfare problems is the highest in these two periods. Further studies could evaluate whether this holds true across European countries with a diverse range of farms.

WelFur aims to be a uniform classification of farms regarding their animals’ welfare. Secondary, the system aims to be useful for farm-specific advice (Mononen et al., 2012). There is a need for further work on implementation of on-farm changes to improve the welfare issues raised in a WelFur assessment. The first step is to develop a report that can be useful for farmers and advisors as background. The feedback given to the farmers in the present PhD study has been through benchmarking of own data compared with data from other project farms, but different farmers might prefer different solutions (Jorgensen et al., 2007).

The feedback from the WelFur assessments can also be used as external input to stable schools. The suggested changes of the stable schools, gained from the interviews with the farmers in Paper III, should be implemented in a revised version of stable schools for mink production to ensure a system that will motivate farmers in contributing to a common learning process towards a common goal. A revised system could be tested over at least two years, and preferably in several countries, in order to measure improvements related to the overall aim and to see if the system is functional in
different countries with different cultures and collaboration practise between farmers. Further studies should also evaluate how to present and how to implement the WelFur results into farm management by stable schools or by other means.
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9 Appendix

Contents

1. Overview of WelFur measurements assessed in the three phases of production

2. Mortality and amount of injuries in assessment period 2 in 2012 and 2013

3. Interview guide, farmers’ perception of stable schools
## Appendix 1: Overview of WelFur measurements assessed in the three phases of production

Table 1.1 Measurements in the WelFur-Mink protocol for welfare assessment of mink (EFBA 2013)

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Sub-measurements</th>
<th>Needed for calculation of criteria scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Body condition score</td>
<td></td>
<td>% of too lean mink (animals in BCS=1 or BCS≤2 in period 1)</td>
</tr>
<tr>
<td>7. Continuous water availability- Type of watering system</td>
<td></td>
<td>% in different situations</td>
</tr>
<tr>
<td>8. Continuous water availability- Functioning and cleanliness of the water points</td>
<td>Incl. additional watering for kits in period 2</td>
<td>% of animals in each of 16, 14 and 22 different situations</td>
</tr>
<tr>
<td>9. Access to a nest box</td>
<td></td>
<td>% of mink with access to a nest box</td>
</tr>
<tr>
<td>10. Resting quality of the nest box/resting area</td>
<td>Dry, clean, not damaged, no fleas</td>
<td>% of animals with a nest box/resting area in the four different qualities</td>
</tr>
<tr>
<td>11. Protection from exceptional weather conditions</td>
<td>Protection from wind (period 1,2,3) Protection from direct sunlight (period 2 and 3) Inside the thermal comfort zone and possibility of cooling (period 2 and 3)</td>
<td>% of animals in different scores (period 1) % of animals in each of 27 possible situations (period 2 and 3)</td>
</tr>
<tr>
<td>12. Nest box material and bedding/nesting material</td>
<td>Insulating capacity (period 1 and 3) Amount of bedding material Protection from draught</td>
<td>% of animals in each of four categories (based on sum of the three sub-measurement scores)</td>
</tr>
<tr>
<td>13. Space available for moving (area and height)</td>
<td>Floor area Cage height Floor area/mink (in period 3)</td>
<td>% of animals in each of the three sub-measurements</td>
</tr>
<tr>
<td>14. Skin lesions or injuries to the body</td>
<td></td>
<td>% of mink in each of three categories</td>
</tr>
<tr>
<td>15. Mortality</td>
<td></td>
<td>% of dead mink during period (period 1 and 3) % of dead mink in each of three sub-periods (period 2)</td>
</tr>
<tr>
<td>16. Diarrhoea</td>
<td></td>
<td>% of mink with evidence of diarrhoea</td>
</tr>
</tbody>
</table>
Appendix I

<table>
<thead>
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<th>17. Lameness or impaired movement</th>
<th>% of mink with evidence of lameness or impaired movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Obviously sick animals</td>
<td>% of mink with evidence of poor health or disease</td>
</tr>
<tr>
<td>19. Killing methods for pelting of mink</td>
<td>% of killing boxes/methods in three different categories</td>
</tr>
<tr>
<td>20. Killing methods for individual mink</td>
<td>% of killing boxes/methods in three different categories</td>
</tr>
<tr>
<td>21. Social housing</td>
<td>% of adult dams housed according to four categories</td>
</tr>
<tr>
<td></td>
<td>% of juveniles housed according to three categories</td>
</tr>
<tr>
<td>Females' social housing, period 3</td>
<td></td>
</tr>
<tr>
<td>Juveniles’ social housing, period 3</td>
<td></td>
</tr>
<tr>
<td>22. Age and procedures at weaning in the summer period (period 2)</td>
<td>% of mink in 20 potential combinations of the sub-measurements</td>
</tr>
<tr>
<td>Age at weaning</td>
<td></td>
</tr>
<tr>
<td>Distance between dams and weaned kits</td>
<td></td>
</tr>
<tr>
<td>Litters kept together</td>
<td></td>
</tr>
<tr>
<td>23. Stereotypic behaviour</td>
<td>% of mink observed performing stereotypies</td>
</tr>
<tr>
<td>24. Cage enrichments</td>
<td>% of mink in each of 27 possible situations</td>
</tr>
<tr>
<td>Different enrichments are divided in three categories based on certainty of the effect on welfare</td>
<td></td>
</tr>
<tr>
<td>25. Fur chewing</td>
<td>% of mink in four categories</td>
</tr>
<tr>
<td>26. Frequency and duration of handling and transportation</td>
<td>Number of handlings per mink in three different levels</td>
</tr>
<tr>
<td>1. &lt; 1 minute</td>
<td></td>
</tr>
<tr>
<td>2. &gt; 1 minute &lt; 1 hour</td>
<td></td>
</tr>
<tr>
<td>3. &gt; 1 hour</td>
<td></td>
</tr>
<tr>
<td>27. Temperament test</td>
<td>% of mink in each of three categories of temperament</td>
</tr>
</tbody>
</table>

References

Appendix II

Appendix 2: Mortality and amount of injuries in assessment period 2 in 2012 and 2013

Table 2.1 Number of females per farm and amount of injuries (any kind of injuries) and mortality, (in % of sample) in assessment period 3 from the ten mink farms participating in stable schools in 2013 (Paper III).

<table>
<thead>
<tr>
<th>Females per farm(period 2)</th>
<th>Animals with injuries 2012 (%)</th>
<th>Animals with injuries 2013 (%)</th>
<th>Mortality 2012 (%)</th>
<th>Mortality 2013 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1370</td>
<td>3.6</td>
<td>1.1</td>
<td>0.7</td>
<td>1.5</td>
</tr>
<tr>
<td>1600</td>
<td>3.7</td>
<td>0.9</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>1650</td>
<td>5.0</td>
<td>3.6</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>1670</td>
<td>0.4</td>
<td>2.7</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>2500</td>
<td>2.3</td>
<td>3.8</td>
<td>0.9</td>
<td>2.7</td>
</tr>
<tr>
<td>2800</td>
<td>3.8</td>
<td>1.8</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>2900</td>
<td>2.9</td>
<td>3.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>3100</td>
<td>7.1</td>
<td>5.5</td>
<td>1.7</td>
<td>1.2</td>
</tr>
<tr>
<td>4300</td>
<td>4.6</td>
<td>2.8</td>
<td>0.9</td>
<td>2.7</td>
</tr>
<tr>
<td>5000</td>
<td>4.3</td>
<td>3.9</td>
<td>1.2</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Appendix I

Appendix 3: Interview guide, farmers’ perception of stable schools

Table 3.1 Interview guide to the research question: How do farmers perceive stable schools as a tool to improve management for the benefit of mink welfare?

<table>
<thead>
<tr>
<th>Themes</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation for joining a stable school</td>
<td>What did you know about stable schools before joining this project?</td>
</tr>
<tr>
<td></td>
<td>Have you been joining similar kinds of groups/meetings?</td>
</tr>
<tr>
<td></td>
<td>What was your motivation for joining the stable school?</td>
</tr>
<tr>
<td></td>
<td>What were your expectations to the stable school?</td>
</tr>
<tr>
<td></td>
<td>Did it matter that it was about animal welfare?</td>
</tr>
<tr>
<td>The visit on your farm</td>
<td>How was it to find a success story and welfare-related problems to work with?</td>
</tr>
<tr>
<td></td>
<td>What kinds of problems/themes were easiest to work with in the group?</td>
</tr>
<tr>
<td></td>
<td>How was it to have the other people in the group on your farm, discussing your farm?</td>
</tr>
<tr>
<td>Changes during the process/year</td>
<td>What do you think about the advice you got from the group?</td>
</tr>
<tr>
<td></td>
<td>Did you follow the advice?</td>
</tr>
<tr>
<td></td>
<td>Did you do any other changes during the year, improving animal welfare on your farm?</td>
</tr>
<tr>
<td></td>
<td>Something you disliked with the stable school?</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Was it something you disliked?</td>
</tr>
<tr>
<td></td>
<td>What could have been done differently, and how?</td>
</tr>
<tr>
<td>Sum up</td>
<td>Is there something you would like to mention before we stop the interview?</td>
</tr>
</tbody>
</table>
The aim of this PhD study was to evaluate the welfare assessment protocol WelFur-Mink to get the assessment as efficient and correct as possible and evaluate stable schools as a tool to improve farm management for better mink welfare. The findings show that it will be possible to reduce the number of measurements needed in different production periods without compromising the validity of the assessment. A potential risk of change in score values within the nursing period has been demonstrated. This might be taken into account by stratifying the assessment within the three annual visits. Stable schools can be useful in utilising knowledge and experiences among mink farmers to improve animal welfare on mink farms, and results from WelFur assessments might be useful information for the group.