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The Swedish breeding cat: population description, infectious diseases and reproductive performance evaluated by a questionnaire

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The questionnaire based study gives a combined description of management, infectious diseases and reproductive performance in breeding catteries during 1 year. The mean number of cats per cattery was 6.1, and 25% of the breeders let some of their cats have free access to outdoors. Breeders reported that infection with feline panleukopenia virus, feline immunodeficiency virus or feline leukaemia virus was uncommon, but 8% of the breeders had sold or had themselves owned a cat that died of feline infectious peritonitis. Presence of conjunctivitis was reported by 33.3% of the breeders. Mean litter size was 3.7 ± 1.5 , with 9.7% stillbirths and 8.3% kitten mortality week 1–12. The percentage of stillborn kittens increased with the age of the queen and litter size, and also differed among breeds. Kitten mortality differed among breeds, but did not increase with age of the queen. Seven percent of the litters were delivered by caesarean section, significantly more during winter and positively associated with presence of stillborn kittens.

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Cat breeding is growing in popularity in Sweden and the number of registered cats within the Swedish Cat Association (SVERAK) increased by more than 100% between 1985 and 2005 (source: www.sverak.se). Today, 33 different cat breeds have been registered in Sweden, the most popular being the Norwegian Forest Cat, Birman, and Persian. Breeding cats are most often kept in groups, and usually in the home environment of the breeder. Whereas domestic cats usually accept other cats, the wild cat, which they originate from, is essentially a solitary animal.¹ As an effect of this, most breeding cats live in environments that differ markedly from the environments in which the domestic cat evolved. As environment is one of the most important factors in determining the incidence and severity of infectious disease, domestic cats might seem to suffer inordinately from infectious diseases.²

Despite the increasing number of purebred cats many breeds are numerically small, leading to few potential breeding animals. Even relatively large breeds are often at risk of inbreeding, due to neutering of many male cats before they have mated, to avoid the behavioural changes accompanying sexual maturity. Another reason for inbreeding is the choice to

breed only with animals within the owner's cattery, eg, to reduce the risk of introducing infectious diseases. In other species, inbreeding is known to have a potentially negative influence on reproductive performance, eg litter size,³ dystocia, and stillbirths.⁴ Inbreeding also affects total puppy mortality, as well as puppy mortality attributable to infection.⁵ Sub-optimal management, including breeding strategy, thus puts cat breeders at risk of experiencing problems with both infectious diseases and reproductive performance.

Multiple-cat households, both breeding catteries and animal shelters, are known risk-environments for infectious diseases.² The dynamics of infectious diseases in shelters has been studied,^{6–9} but information on the importance of infectious diseases in breeding catteries is scant. The reproductive performance of pedigree cats has been described, often concentrating on litter size and kitten mortality.^{10–15}

Information regarding management and prevalence of infectious diseases in breeding catteries is valuable when discussing prophylactic measures, treatment and other measures to undertake after diagnosing an infection. Poor management, including poor breeding programmes, and infectious diseases might lead to a reduced reproductive performance. The present study aims to describe the situation in breeding catteries regarding management, prevalence of infectious

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diseases and reproductive performance, from the breeders' point of view.

Material and methods

Selection of breeding catteries

In order to obtain the viewpoint of active breeders, questionnaires were distributed by The Swedish Cat Association, SVERAK, to breeders that had registered two or more litters in SVERAK during the previous year (2001, $n = 519$). A letter was attached to the questionnaire, explaining that the questions concerned cats that were kept together in one cattery, and that cats housed in other households were not to be considered. Breeders could remain anonymous to the authors if they wished to. No reminders were sent out.

Questionnaire design

The breeders were asked to report on the situation the previous year, and some questions also concerned the situation from the time they started breeding. The questionnaire was divided into different sections: general management, infectious diseases and vaccinations, and reproductive performance.

The general information considered breeds, duration of breeding, number of cats, including age and gender, size of the area where cats were kept, and if they were allowed outdoors. Breeders were also asked if their cats had been taken abroad, and, if so, to which countries.

The part of the questionnaire that dealt with infectious diseases in the cattery covered upper respiratory tract disease (URTD), feline coronavirus (FCoV) and feline infectious peritonitis (FIP), feline panleukopenia virus (FPV), presence of feline immunodeficiency virus (FIV) or feline leukaemia virus (FeLV), dermatophytes and ectoparasites. Questions regarding vaccinations were included.

Finally, information about reproductive performance was requested. These questions covered several aspects of reproduction including the number of successful matings and matings that did not result in pregnancy. For each litter, breeders were asked for information on the month of birth, age of the queen, type of parturition, the number of kittens born, gender, if they were live or dead, and how many kittens that died during the first 12 weeks of life.

Data analysis

Associations between breed and number of cats per cattery, presence of conjunctivitis or URTD were tested using Fisher's exact test.

Differences in reproductive performance were investigated using different regression models. The four outcome variables were: (1) litter size, (2) dystocia, ie, caesarean or medically treated uterine inertia,

(3) stillbirth, and (4) kitten mortality post partum. Litter size was defined as the total number of kittens (live or stillborn) in each litter at parturition. It was treated as a continuous variable and a linear regression model was used to test the significance of possible explanatory variables. The probability of dystocia, on the other hand, was modelled using logistic regression. The probability of stillbirth and of kitten mortality for the first 12 weeks post partum were both investigated using negative binomial regression. The exposure variables in these models were the total number of kittens (live or stillborn) in the litter and number of live kittens at partus, respectively. In all, the potential covariates considered for inclusion in the initial models were: breed, season, age of queen, litter size, presence of stillborn kittens in the litter and caesarean section. For breed comparisons, the Norwegian Forest Cat was chosen as the baseline breed because it was one of the numerically largest breeds, mesocephalic, and without marked conformational variations.

Descriptive statistics and statistical analysis was performed using Stata statistical software release 9.2 (Stata Corp, College Station, TX, USA). Because data could be assumed to be clustered (ie, litters within catteries), possible cluster effects were adjusted for by applying robust standard errors (ie, option 'cluster' in the specific Stata regression commands).

Results

Of the 519 breeders receiving the questionnaire, 51% (265) responded. One of these had stopped breeding cats and the results from this study are thus based on 264 completed questionnaires from an equal number of breeders.

General information

The breeders had been active for 1 to 37 years, with a mean of 10 ± 6.9 (standard deviation, SD) years. The majority (73%) bred one breed, 25% bred two breeds and only a few (2%) bred three breeds. In addition, 24% kept one or more domestic shorthair cats in the cattery. The most common breeds were Birman (21% of breeders), Norwegian Forest Cat (14%), Persian (10%) and British Shorthair (4%, Table 1). The most common combinations of two breeds were Persian/Exotic (35% of breeders) and Oriental Shorthair/Siamese (8%). Due to their genetic similarity, Persians and Exotics were grouped together in the statistical evaluation, as were Oriental Shorthair and Siamese cats.

The average total number of cats per cattery was 6.1 ± 3.4 : 0.8 male cats, 1.0 neutered male, 3.4 female cats and 0.9 neutered females (Table 1). The number of cats differed depending on breed: breeders of British Shorthair and Persian/Exotic had significantly more cats than those of Oriental Shorthair/

Table 1. Number of breeders, litters and litter data for different breeds

Breed	Number of breeders	Mean number of cats per cattery, <i>n</i>	Mean number of litters per cattery, <i>n</i>	Number of litters, <i>n</i>	Litters delivered after treatment, %	Mean litter size, <i>n</i>	Mean number of stillborn kittens, %	Mean kitten mortality week 1, %	Mean kitten mortality weeks 2–3, %	Mean kitten mortality weeks 4–12, %	Mean kitten stillbirth and mortality, %	Mean number of kittens surviving after 12 weeks, <i>n</i>
BRI	11	4.2	7.7	36	16.7	3.7	19.7	3.8	3.9	1.0	26.5	2.7
NFO	38	14.4	6.5	85	4.7	4.1	3.4	5.1	1.3	1.9	11.2	3.6
ORISIA	14	5.3	4.9	33	6.1	4.6	7.2	9.9	4.7	3.3	23.0	3.5
PEREXO	50	18.9	7.5	158	7.0	3.4	12.2	8.6	2.5	2.6	23.8	2.6
RAG	11	4.2	5.7	23	4.3	4.0	4.3	3.4	1.2	0.0	8.7	3.7
RX	16	6.1	4.9	38	2.6	3.8	4.2	4.4	0.8	1.5	10.5	3.4
SBI	55	20.8	5.0	142	12.0	3.2	12.9	3.8	1.3	0.5	17.8	2.6
Others	69	26.1	6.0	179	8.4	3.9	9.5	4.8	2.8	1.2	17.3	3.3
Total	264	100.0	6.1	694	8.2	3.7	9.7	5.7	2.2	1.5	18.1	3.0

NFO = Norwegian Forest Cat, BRI = British Shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds.

Siamese, Cornish and Devon Rex, or Birman. The mean area where cats were kept was 129 m² (11–590 m²) and most breeders (74%) kept all cats together. Seventy percent kept their cats strictly indoors, and 25% let some or all cats have free access to outdoors.

Forty-two percent of breeders had travelled abroad with their cats, most to neighbouring countries: Norway (80%), Denmark (16%), Finland (15%) and Germany (6%).

Vaccinations

Ninety percent had the kittens first vaccinated at 8–10 weeks of age, and 62% had them vaccinated twice before sale. Follow-up vaccination schedules for individual kittens were the responsibility of their new owners. In 50% of catteries an inactivated vaccine against FPV, feline herpesvirus (FHV) and feline calicivirus (FCV) was used, in 19% a live attenuated vaccine and in 31% both inactivated and live vaccines against these viruses were used. These proportions were similar for adult cats. Few breeders additionally had their kittens vaccinated against chlamydiosis and FIP. Adult cats were usually revaccinated yearly.

Infectious diseases

General

In total, 33.3% of the breeders reported having had cats with conjunctivitis the previous year, 14% only in kittens and 10% only in adults. The majority of these (71%) reported that no aetiological diagnosis was made. The most commonly diagnosed aetiological agent was *Chlamydophila felis* (*C felis*, 7%). The reported prevalence of conjunctivitis and other URTD varied among breeds ($P = 0.027$ and $P = 0.015$, respectively), with Persians and Exotics having a higher and Birman a lower frequency than expected (Table 2).

Infections with FPV or FIV had not been diagnosed within any of the catteries the previous year, and FeLV had only been detected in one single cattery. The number of tests performed was not reported. Lice were not reported by any breeder, whereas fleas, cheyletiellosis and dermatophytes were reported by 1.5%, 0.4% and 1.1%, respectively.

Fifteen percent of the breeders had the previous year tested cats for antibodies against FCoV, and 34% of these had seropositive cats. Three percent of the breeders ($n = 7$) had lost a cat in FIP the last year, five of these a cat younger than 1 year. Seven percent of the breeders ($n = 17$) had sold a cat that developed FIP, in 11 cases when 1 year old or younger. Two of these breeders both had sold and themselves had a cat with FIP. Twenty-three percent knew that they had cats with antibodies against FCoV, but the majority, 59% had never checked antibody titres in the cattery.

Table 2. Breeders reporting signs of conjunctivitis and URTD

Breed	Average number of shows per breeder	Number of breeders reporting conjunctivitis						Number of breeders reporting other upper respiratory signs					
		In general			After show			In general			After show		
		<i>n</i>	<i>N</i>	%	<i>n</i>	<i>N</i>	%	<i>n</i>	<i>N</i>	%	<i>n</i>	<i>N</i>	%
BRI	5.3	4	11	36.4	0	9	0.0	2	11	18.2	0	9	0.0
NFO	9.8	13	38	34.2	1	36	2.8	8	38	21.1	3	36	8.3
ORISIA	7.3	7	14	50.0	2	12	16.7	3	14	21.4	1	12	8.3
PEREXO	8.9	25	50	50.0	9	35	25.7	18	50	36.0	12	35	34.3
RAG	6.1	2	11	18.2	1	10	10.0	0	11	0.0	0	10	0.0
RX	6.7	2	16	12.5	0	14	0.0	2	16	12.5	2	14	14.3
SBI	5.4	13	55	23.6	2	42	4.8	6	55	10.9	4	42	9.5
Others	6.4	22	69	31.9	7	54	13.0	10	69	14.5	9	54	16.7
Total	7.2	88	264	33.3	22	212	10.4	49	264	18.6	31	212	14.6

NFO = Norwegian Forest Cat, BRI = British Shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds.

Infectious diseases after shows and boarding

Thirteen percent of the breeders had not attended any cat show the preceding year. Sixty-one percent had showed cats 1–9 times, and 26% had attended 10–26 cat shows. After shows, 10.4% of the breeders reported having seen conjunctivitis in cats and 14.6% had noted other signs of URTD. There was a significant variation among breeds ($P = 0.003$) concerning conjunctivitis after shows, whereas the breed variation for other signs of URTD was non-significant ($P = 0.06$, Table 2). Very few (0.87%) had experienced problems with ectoparasites or dermatophytes after visits to shows. Few breeders (1.5%) had boarded cats, and no clinical signs of disease were associated with this.

Reproduction

Breeding contacts between catteries

Matings with queens and tom cats within the owner's cattery were reported by 58% of the breeders. Bringing a queen to tom cats in other catteries for mating was reported by 56%, while bringing a tom cat from outside the cattery to the queens was reported by 23% of the breeders. Correspondingly, 10% had sent their tom cat to another cattery for mating the previous year. Most breeders (68%) had not received any queens from outside for mating, but 5% had received a queen from outside for mating >5 times the previous year.

Matings not resulting in litters

Sixty-eight percent of the breeders reported that all matings last year had resulted in pregnancy. Matings that did not result in pregnancy occurred all over the year. Seemingly, it sometimes happened that

a presumably pregnant queen did not have kittens – 10% of the breeders had experienced this once or more the previous year, but only 24% of these breeders had the pregnancy diagnosis made by a veterinarian.

Distribution of parturitions

The mean number of litters per breeder was 2.8 (range: 0–7, Table 1), with a total of 694 litters reported. The average age of the queen was 3.3 (range: 0.75–10 years) and most litters were born to queens 1–3 years old (Fig 1). The litters were distributed all over the year, with the highest number of litters born in March to July (Fig 2).

Litter size

The mean litter size was 3.7 (range: 1–10), with an average of 9.7% stillborn kittens and 8.3% kitten mortality week 1–12. The litter size did not vary over the

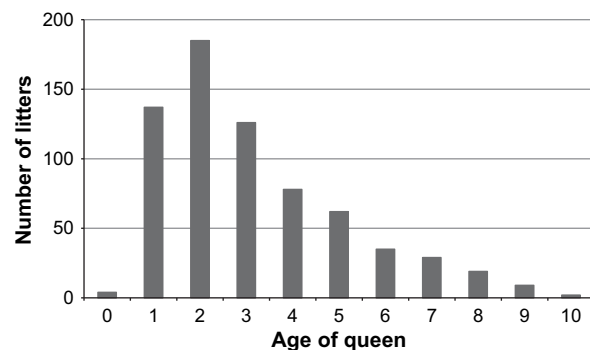


Fig 1. Total number of litters born in queens of different ages.

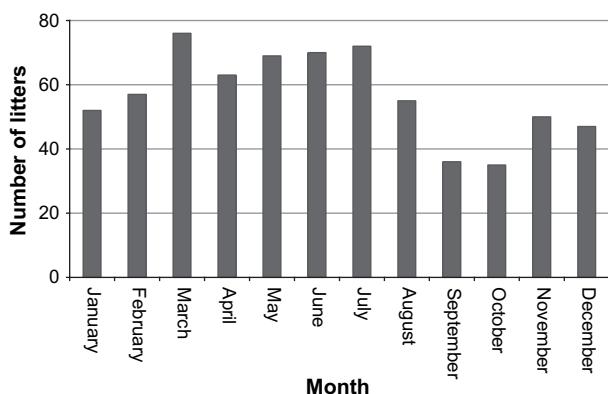


Fig 2. Total number of litters born per month.

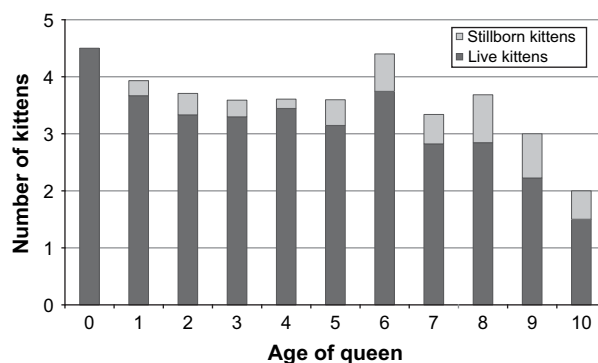


Fig 3. Litter size, and number of stillborn and live born kittens, related to age of the queen.

year. Litter size varied among breeds ($P < 0.001$, Tables 1 and 3). The litter size tended to decrease in queens 7 years and older (Fig 3).

Dystocia

Seven percent of the litters were delivered by caesarean section, and in 1% of the cases the kittens were delivered after medical treatment of the queen. The percentage of dystocia varied among breeds (Table 1), but this variation was not statistically significant. The presence of one or more stillborn kittens, on the other hand, was significantly associated with caesarean sections (odds ratio, OR = 3.7), as was season: Significantly more parturitions resulted in caesarean section during December to February compared to the rest of the year (OR = 2.2, Table 4). Dystocia was

significantly associated with litter size ($P = 0.02$), and was more common in very small or in large litters (Fig 4, Table 4).

Stillbirths

The number of stillborn kittens per litter varied among breeds ($P = 0.0001$, Table 1) and was associated with increasing age of the queen ($P < 0.001$), especially so for queens >5 years (Fig 3), as well as with litter size ($P < 0.001$, Fig 5, Table 5). There were no stillborn kittens in 77% of the litters, and one stillborn kitten in 15% of the litters.

Kitten mortality post partum

Kitten mortality post partum varied among breeds ($P = 0.004$, Table 1, Fig 6) but was not associated with age of the queen, with the exception of queens less than 1 year old, who had a significantly higher kitten mortality (incidence risk rate, IRR = 5.8, $P = 0.006$, Table 6). Kitten mortality increased with litter size ($P = 0.001$, Fig 7) and was associated with

Table 3. The effect of breed on litter size. Litter size is treated as a continuous variable, analysed with a linear regression model

Covariate	Coefficient	P	95% Confidence interval	
			Lower limit	Upper limit
Outcome: Litter size				
Breed				
NFO	Baseline breed			
BRI	-0.427	0.223	-1.117	0.262
ORISIA	0.512	0.195	-0.264	1.288
PEREXO	-0.581	0.011	-1.026	-0.136
RAG	-0.094	0.817	-0.892	0.704
RX	-0.331	0.342	-1.016	0.354
SBI	-0.903	0.000	-1.320	-0.485
Others	-0.144	0.524	-0.590	0.301
Constant	4.094	0.000	3.731	4.457

NFO = Norwegian Forest Cat, BRI = British Shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds. $n = 689$.

Table 4. Effect of litter size, winter and stillbirth on probability of dystocia, modelled using logistic regression

Covariates	Fractional polynomial powers*	Odds ratio	P	95% Confidence interval	
				Lower limit	Upper limit
Outcome: Dystocia					
Litter size	1	0.661	0.007	0.489	0.895
	3	1.004	0.065	1.000	1.008
Winter	na	2.207	0.014	1.175	4.143
Stillbirth	na	3.741	0.000	2.080	6.730

na = not applicable. $n = 677$.

*Best-fitting fractional polynomial powers of independent variable.

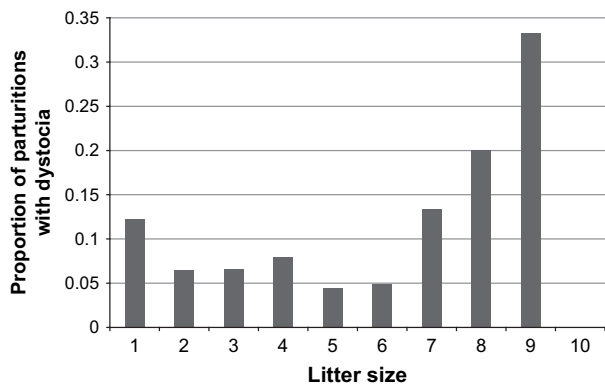


Fig 4. Proportion of parturitions with dystocia related to litter size.

caesarean section (IRR = 2.3, $P = 0.001$, Table 6). During the first week, kitten mortality was seen in 13% of the litters, and decreased the following weeks (Fig 6). Usually, only one kitten was reported dead per litter and time period. Male kittens were over represented in the age group 4–12 weeks: in 64% of the litters with kitten mortality in this age group, all kittens that succumbed were male.

Discussion

This is the first study combining description of management, infectious diseases and reproductive performance in breeding catteries from the breeders’ point of view. All data are breeder reported, and not controlled by veterinarians. The fact that the study is retrospective might negatively affect its accuracy. However, the general study period was limited to the previous year, and the recall bias should, therefore, be manageable. All breeders in the target population received a questionnaire and were thus potentially included in the study population. As expected, all did not respond, and the effect of a possible

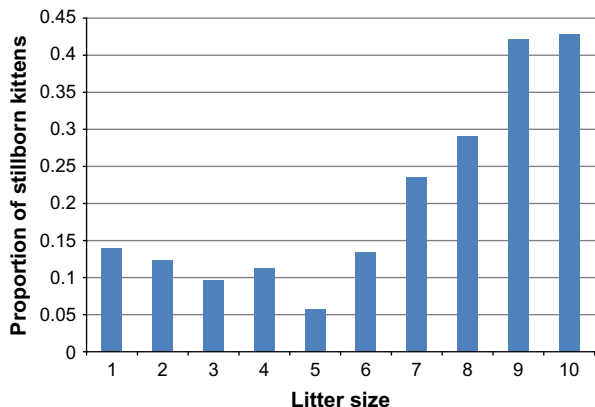


Fig 5. Proportion of stillborn kittens in litters related to litter size.

Table 5. Probability of stillbirth depending on breed, age and litter size, investigated using negative binomial regression

Covariates	Fractional IRR polynomial powers*	P	95% Confidence interval	
			Lower limit	Upper limit
Outcome: Incidence of stillbirth				
Breed				
NFO	Baseline breed			
BRI	na	8.179	0.000	3.429 19.509
ORISIA	na	3.236	0.039	1.062 9.854
PEREXO	na	5.552	0.000	2.536 12.156
RAG	na	2.060	0.310	0.511 8.310
RX	na	2.034	0.353	0.455 9.104
SBI	na	5.631	0.000	2.565 12.360
Others	na	3.332	0.003	1.511 7.346
Age	3	1.002	0.000	1.001 1.002
Litter size	2	0.916	0.013	0.854 0.981
	2	1.049	0.002	1.017 1.082

NFO = Norwegian Forest Cat, BRI = British shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds. $n = 681$, na = not applicable.

*Best-fitting fractional polynomial powers of independent variable.

selection bias is not known. The three most common breeds in the survey were those most common in Sweden: Birman, Norwegian Forest Cats and Persian. In other studies, other breeds predominate.^{10,11,14,15} As several traits differ among breeds, this must be taken into account when comparing results from

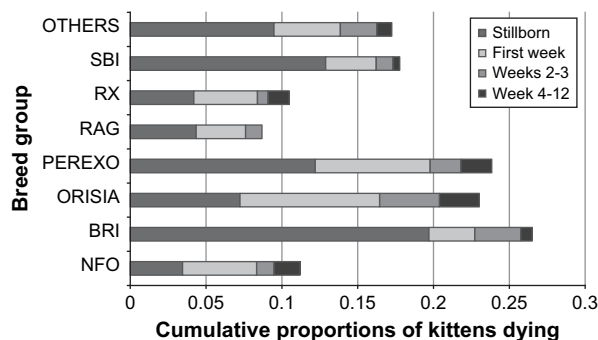


Fig 6. Kitten mortality in different breeds. NFO = Norwegian Forest Cat, BRI = British Shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds.

Table 6. Probability of kitten mortality post partum depending on breed, age and litter size, investigated using negative binomial regression

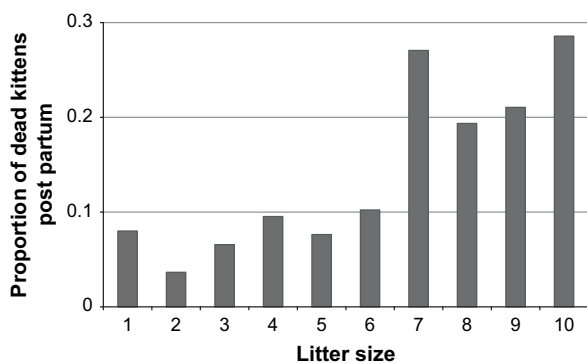
Covariates	Fractional polynomial powers*	IRR	P	95% Confidence interval	
				Lower limit	Upper limit
Outcome: Incidence of kitten mortality post partum					
Breed					
NFO	Baseline breed				
BRI	na	1.241	0.720	0.381	4.045
ORISIA	na	2.221	0.042	1.029	4.795
PEREXO	na	1.918	0.055	0.986	3.730
RAG	na	0.605	0.299	0.235	1.560
RX	na	1.003	0.995	0.406	2.478
SBI	na	0.893	0.770	0.419	1.906
Others	na	0.935	0.845	0.475	1.840
Queen < 1 year	na	5.781	0.006	1.658	20.157
Litter size	3	1.002	0.000	1.001	1.004
Dystocia	na	2.307	0.001	1.388	3.835

NFO = Norwegian Forest Cat, BRI = British Shorthair, ORISIA = Oriental Shorthair and Siamese, PEREXO = Persian and Exotic Shorthair, RAG = Ragdoll, RX = Devon Rex and Cornish Rex, SBI = Birman, Others = Other breeds and other combination of breeds. na = not applicable.

*Best-fitting fractional polynomial powers of independent variable.

different studies, together with factors such as varying management practices.

The mean number of cats per cattery was 6.1, and the majority of breeders kept their cats strictly indoors. However, as many as 25% let all or some of their cats have free access to outdoors. These cats are at risk of encountering infections that are not usually a problem for cats kept indoors, such as FIV. Even if only some cats in a group can

**Fig 7.** Kitten mortality post partum related to litter size.

roam freely, these can in turn infect the indoor cats. However, FIV is not a common infection in Sweden, and in this study no breeder had a cat tested positive for FIV the previous year. Only one breeder had a case of FeLV diagnosed in the cattery. It should be emphasised, that is not known to what extent breeders in the present study have tested their cats for FIV and FeLV. Outdoor cats are at risk of acquiring FeLV in endemic areas, especially when young, but the present study indicates that this infection route is not a major risk for breeding cats. FeLV can also be a problem in indoor cats and especially breeding animals. When introducing new cats into a household, or when mating with cats from other catteries, testing against FIV and FeLV is advisable.¹⁶

Outdoor cats are also exposed to environmental infections, such as FPV, but none of the breeders in this survey reported a case of feline panleukopenia. One explanation for this may be that most cases of kitten mortality do not get an aetiological diagnosis. FPV has previously been shown to cause mortality in kittens in breeding catteries.¹⁷ Another possible explanation is that effective vaccination regimes in breeding catteries reduce the risk of disease. In a previous investigation, infectious diseases were identified in 55% of kitten mortality, and 25% of all kitten mortality was due to FPV.¹⁸ When studying kittens with viral disease, it was demonstrated that non-pedigree kittens were significantly more likely to have a diagnosis of FPV than pedigree kittens.¹⁸

Most breeders vaccinated kittens the first time at 8–10 weeks of age. All breeders vaccinated the kittens against FPV, FCV and FHV, which is in accordance with the recommendations from the Swedish Small Animal Veterinary Association and also the World Small Animal Veterinary Association that categorises these vaccines as 'core'.¹⁹

Upper respiratory signs were frequently reported by breeders; they were reported by 19% and conjunctivitis by 33.3%, with a significant variation among breeds and the highest number in Persians and Exotics. These numbers include a potential bias, as the data are retrospective, which can lead to an underestimation, but also overestimation, of the frequency of disease. In addition, definitions may differ among breeders. *C felis* is an important ocular pathogen,²⁰ and was the single most common pathogen diagnosed in the present survey, although no diagnosis was made in the majority of cases. Even if infections with *C felis* can be treated successfully, extended treatment periods are required to eliminate the infection.²¹ As most cases of ocular infections in catteries never get an aetiological diagnosis, it can be assumed that several cats infected with *C felis* are not receiving appropriate treatment, increasing the opportunity for spread of *C felis* and an endemic situation in catteries. This is also supported by the fact that 18% of Swedish purebred cats had antibodies to chlamydiae in a previous serosurvey.²²

The importance of cat shows for spread of infectious diseases is unclear. Although several precautions are usually undertaken to avoid spread of infections, it is an occasion with a concentration of many cats that can be subclinically infected and potentially excreting the infectious agent. In addition, when signs of infectious diseases occur, cat owners are prone to search for association with a special occasion or event, such as a show. Ectoparasites can spread, but less than 1% of breeders reported acquiring dermatophytosis after a show the previous year and ectoparasite infections were generally uncommon. In contrast, an average of 10.4% of breeders reported conjunctivitis in cats after shows, with a significant variation among breeds, and 14.6% reported other upper respiratory signs after shows. Clinical signs might be due to reactivation of latent infections, due to new infections acquired, due to non-infectious causes and may or may not be related to showing. Due to the brachycephalic anatomical conformation of Persian and Exotic breeds, they are also more prone to ocular problems and dyspnoea.^{23,24} As the diagnoses in the present survey were made by the owners, this might result in an overestimation of reports of conjunctivitis and rhinitis in these breeds. On the other hand it can be argued that owners are used to these clinical signs, and regard them as normal for the breed.

Eight percent of the breeders either had a cat or sold a cat that died from FIP the previous year. It has previously been reported that 5–10% of seropositive kittens in endemic households develop FIP.²⁵ Although the majority of breeders in the present study never had checked antibody titres against FCoV in the cattery, it is known that FCoV is often endemic in catteries, and approximately 65% of Swedish purebred cats are seropositive.²² FCoV infection can be eliminated from cat colonies by a testing and isolation procedure.²⁶ Despite the high prevalence of the virus, and the relatively high proportion of breeders experiencing this lethal disease, according to the present study, most Swedish breeders do not undertake any control measures against FCoV infection.

The cat is a seasonal breeder, and most litters were born between March and July while fewer litters were born in September and October. This is a similar pattern to the one seen in free-roaming cats.²⁷ There was no corresponding lower litter size during the months with lowest number of litters. A seasonal effect on litter size has been described in a dog breed.²⁸ Season may affect several aspects of reproduction. In cattle, season has been shown to affect the conception rate (eg, Gustafsson and Emanuelsson),²⁹ but no effect of season on conception rate was detected in the present study.

The mean litter size in the present survey (3.7 kittens) was identical to the litter size described in a colony of 14 cats³⁰ and in a North American questionnaire survey¹¹ but smaller than in other studies,

where four to five kittens per litter have been reported.^{10,12,15} There was a variation among breeds regarding litter size, with Persian/Exotic and Birman having smaller litters.

There was a significantly higher risk for dystocia in December to February. The cause for this is unknown but, as the cat is a seasonal breeder, it is noteworthy that these are the months when the decrease in daylight culminates in Scandinavia. The risk for dystocia is also higher with the presence of a stillborn kitten, in accordance with a previous study,¹⁵ but the causal relationship is not known. The proportion of litters delivered by caesarean section was on average 7.2%, with 90.5% of litters delivered without any medical or surgical intervention. These numbers are similar to those in previous studies.^{15,31} Maternal causes, mainly uterine inertia, are the most common causes of dystocia in cats,³² and in brachycephalic breeds foetal malpresentation is also common.³¹ The effect of litter size was in litters with only one kitten probably due to insufficient stimulation to initiate labour, while in cases with larger litters overstretching of the myometrium causing inertia is a more likely cause. Breed did not have a significant independent effect on dystocia, indicating that factors other than breed are more important risk factors for dystocia, as previously suggested by Sparkes et al.¹⁵ Both litter size and presence of stillborn kittens were not only associated with dystocia but also differed significantly among breeds.

The percentage of stillborn kittens increased significantly with age of the queen, as has been previously suggested¹² but in contrast to another study.¹⁵ This discrepancy may be related to that the queens in the present study were generally older (mean 3.3 years vs 2.8 years). The percentage of stillborn kittens increased with larger litter size, as previously described,¹⁵ and also differed significantly among breeds. In Birman, British Shorthair and Persian/Exotic the percentage of stillborn kittens was over 10%. It has been suggested that a high proportion of stillborn kittens in Persians is related to a disproportionately high braincase that causes mechanical obstacles during the birth process.²⁴ The mean percentage of stillborn kittens, 9.7, in the present study is slightly higher than in previous studies.^{10,15,30} Kitten mortality including stillborn kittens and mortality from week 1 to 12 was 18.1%, and the percentage surviving kittens at 12 weeks thus 81.9%. These values are in the same range as previously reported.^{10,15} In the cat colony studied by Root et al,³⁰ overall kitten mortality was higher, and only 70.1% of the kittens had survived by 8 weeks of age. As in previous studies, the majority of kitten mortality in the present study occurred during the first week after birth. As for stillbirths, kitten mortality post partum differed significantly among breeds. In Oriental Shorthair/Siamese and Persian/Exotic it was over 10%.

In conclusion, conjunctivitis and URD are commonly occurring problems in breeding cats despite

regular vaccinations. Although Swedish breeding catteries are of moderate size, with a mean of six cats, FIP is a challenge to breeders: 8% had experienced this fatal disease. Despite this, measures to control FCoV infection are rarely undertaken. Breed affects several outcomes, both infectious (prevalence of conjunctivitis and URTD) and breeding parameters (litter size, still-born kittens and kitten mortality). A careful breeding strategy should, therefore, enable both a reduction of infectious disease and an improvement of reproductive outcome.

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Supplementary material

Supplementary material associated with this article can be found in the online version at doi: [10.1016/j.jfms.2009.03.008](https://doi.org/10.1016/j.jfms.2009.03.008).

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