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## Preliminary survey of congenital and reproductive disorders in the New Zealand Miniature horse population

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### ABSTRACT

The Miniature horse population is a rapidly expanding sector of the New Zealand (NZ) equine population. It is estimated that there have been 6,052 Miniature horses registered in NZ, with 677 new registrations in 2004. The lay literature implies that the Miniature horse breed has a high level of reproductive and congenital defects. To obtain reference data on the reproductive and congenital disorders of the NZ Miniature horse breed a face-to-face survey was conducted with 22 breeders located in the lower North Island of NZ. The 22 breeders were the owners of 421 horses (246 mares, 52 stallions, 88 foals and 35 geldings). The mean number of Miniature horses on the property was 19 horses (range 4 – 60), 11 broodmares (range 2-30) and 2 stallions (range 0 – 8). Most horses (75%) were registered with the NZ Miniature horse Association or the American Miniature Horse Society (23%). Most Miniature horses were type A, being  $\leq 86$ cm in height at the withers (72%). The average foal crop per breeder was 7 foals, which were conceived with hand serving (61.4%) or a combination of hand serving and having the stallion run with the mare (31.8%). Confirmation of pregnancy was by blood test (49.2%), ultrasound verification (19%), combination of blood test and ultrasound (6%), or non return to oestrus (23.4%). Seventeen breeders had mares that were covered by the stallion during the season but did not return a positive pregnancy (23.4% of mares covered in the season). There was a lower percentage of apparent fetal loss on farms that used blood tests or ultrasound to verify pregnancy compared to farm relying on non return to oestrus ( $10.38\% \pm 2.49\%$  vs.  $20.79\% \pm 4.59\%$ ,  $p=0.06$ ). The incidence of fetal abortion ( $<300$  days gestation) was 1.75% (CI 0.5-3.03), and 5.2% (CI 2.6 -7.8%) of mares suffered from dystocia. The incidence for premature placental separation was 0.82% (CI 0.26-1.39%) and the incidence of retained placenta was 1.4% (CI 0 -3.6%). The incidence of dwarfism was 0.7% (CI 0.11-1.28%), with 11 breeders reporting foals that had excluded from the studbook due to dwarfism. The incidence of parrot and sow mouth was 1.22% (CI 0 -2.43%) and 0.45% (CI 0 – 0.84%), respectively. The incidence of respiratory disorders (including signs indicative of collapsed trachea and cleft palate) was 2.2% (CI 0.7 -3.7%). The data collected indicate that the incidence of reproductive and congenital disorders in the New Zealand Miniature horse population is lower than expected.

**Keywords:** Miniature horse; reproduction; inbreeding; congenital defects.

### INTRODUCTION

The miniature horse is a recent phenomenon in recreational horse breeds. The American Miniature horse stud book was formed in 1978 and focuses on the production of horses that are less than 86cm (Type A) or 97 cm (Type B) in height at the withers. To obtain horses that meet the height requirement there has been vigorous selection for decreased stature, inbreeding and in some cases the use of sires that displayed obvious signs of dwarfism. (USA Miniature horse, [www.mini-horse.org](http://www.mini-horse.org)).

Analysis of microsatellites indicates that there is still significant within breed variation in the American Miniature horse breed (estimated heterozygosity of  $0.579 \pm 0.038$ ) (Bowling and Ruvinsky 2000). However, anecdotal reports of congenital defects indicate that at least for some

genes there may existing a high level of homozygosity.

It is estimated that since the introduction of the first Miniature horse breeding stock in NZ approximately 25 years ago that some 6,052 horses have been registered with the NZ Miniature horse association (NZMHA) and that the annual foal crop is around 700 foals per year (NZMHA, [www.nzmha.co.nz](http://www.nzmha.co.nz)). The majority of the NZ Miniature horse population have been produced as a result of crossing imported American Miniature horses with Timor and Shetland ponies. The NZMHA association is the major stud book in NZ.

In other horse breeds, such as the Friesian, rapid expansion of the population from a limited genetic base has been associated with the fixation of such traits as an increased incidence of retained placenta (Sevinga et al. 2004b).

Internationally there has been anecdotal evidence of a higher incidence of congenital abnormalities and reproductive disorders in the Miniature horse population than observed in other horse populations or breeds. In an unpublished survey it was estimated that US miniature horse breeders lose up to 1/3<sup>rd</sup> of the foals during gestation and birth (USA Miniature horse. Origin of Dwarf horses [www.mini-horse.org/dwarf\\_horse\\_genes.html](http://www.mini-horse.org/dwarf_horse_genes.html); USA Miniature Horse. Genetic mechanisms in equine dwarfism ). Frankeny (2003) suggests the Miniature mares may be more prone to abortions and dystocia compared to full-sized mares, and suggests that abortions are frequently associated with a malformed fetus, while the increase risk of dystocia may be due to the small size of the mare, and the domed-shaped forehead of the Miniature horse foal.

Within NZ there appears to be no literature available describing the size and nature of the NZ Miniature population. The paper describes a preliminary survey of the congenital and reproductive disorders of the NZ Miniature horse population.

## MATERIALS AND METHODS

A sample of 22 Miniature horse breeders in the lower half of the North Island of NZ was identified from breeder's details provided by the NZMHA. After an initial introductory phone call a face-to face-interview was conducted at the breeders' property. The interview consisted of a 3 page survey that was a mixture of closed and open ended questions. The survey collected information on the size of the breeding operation and the reproductive performance of the breeding stock, including pregnancy rates, apparent fetal loss after pregnancy diagnosis, dystocia, premature separation of the placenta (red bag) and retained placenta. Retained placenta was defined as the failure of fetal membranes to be passed within 3 hours of delivery. Owners were also questioned on the number of male horses in which testicles failed to descend. Information was also collected on observations of presumed congenital and genetic disorders such as dwarfism, tracheal collapse, brachygnathism (parrot mouth) and prognathism (sow mouth), and the level of veterinary care or support.

The data was grouped into categorical variables and entered into MS Excel for exploratory data analysis. The incidence rate data is expressed as per horse observation years. This was calculated by recording the number of observed cases of a disorder recorded by the

breeder and correcting for the number of foals bred and the number of years breeding.

## Statistical analysis

Comparisons between groups for parametric data were performed using the General linear model procedure in SPSS v12.1 (SPSS Chicago, IL, USA). Incidence rate and 95% confidence intervals were calculated within SPSS V12.1. For all analyses the significance level was set at  $P < 0.05$ .

## RESULTS

The 22 breeders had been breeding other breeds of horses for an average of 30 years (range 0- 60 years) before breeding Miniatures, and had been breeding Miniature horses for an average of 10 years (range 3 – 35 years). The breeders were owners of 421 horses of which 246 were mares, 52 stallions, 88 foals and 35 were geldings. The size of the breeding operation varied considerably, the average number Miniature horses on each property was 19 (range 4 - 60), the average number of stallions was 2 (range 0 – 8) and the average breeding herd was 11 broodmares (range 2 – 30).

The majority of the horses were registered with the NZMHA (74.8%), the American Miniature horse society (23.3%), and the remaining horses with the Falabella (1.4%) and the Australian Miniature horse society (1.4%). The majority of the horses were type A (72%) and the remainder were type B (28%).

## Breeding

The 22 breeders produced an annual foal crop of 145 foals. The average foal crop varied between studs, the average being 7 foals per year (range 1 – 21 foals per year). The majority of the breeders hand served the mares (n=14 breeders, 61.4% of sires), six breeders (31.8% of sires) used a combination of hand serving and having the stallion run free with the mares and two breeders (6.8% of sires) had the stallion running with the mares as the sole breeding technique.

## Reproduction

Confirmation of pregnancy was predominantly by blood test (10 breeders, 49.2% mare population), transrectal or transabdominal ultrasonic scanning (4 breeders, 19.9% mare population), blood tests and transrectal or transabdominal ultrasonic scanning (n=3 breeders, 6.1% mare population), and verification of pregnancy by non-return to oestrus (5 breeders, 24.8 % mare population). Seventeen breeders had mares that were covered by the stallion during the

season but did not return a positive pregnancy (n=34, 23.4%).

Fifteen breeders had mares that were tested or believed to be pregnant but failed to produce a live foal. The mean incidence of apparent fetal loss was 11% (range 0 -33%) of confirmed pregnancies. Studs that utilised ultrasound scanning or blood tests to verify pregnancy (n=17) had a lower percentage of apparent fetal loss compared to the studs utilising non-return to oestrus as an indicator of positive pregnancy (10.38% (SE 2.49) vs. 20.79% (SE 4.59), p=0.06).

Twelve of the studs had observed aborted fetuses during their Miniature horse breeding career, yielding an estimated population abortion incidence of 1.75 % (CI 0.5 -3.03%) (Table 1).

**TABLE 1:** The estimated population incidence (and 95% CI) of congenital and reproductive disorders in the New Zealand Miniature Horse.

	Incidence (95% CI)	
<b>Reproductive</b>		
Aborted fetus (<300 days gestation)	1.75%	0.5-3.03%
Dystocia	5.2%	2.6-7.8%
Premature placental separation	0.82%	0.26-1.39%
Retained placenta	1.4%	0.0-3.6%
<b>Congenital</b>		
Dwarfism	0.7%	0.11-1.28%
Sow mouth	1.22%	0.00-2.43%
Parrot mouth	0.45%	0.0-0.84%
Cryptorchids	1.34%	0.3-2.45%
Patella luxation/subluxation or upward fixation of patella	2.91%	0.36-5.5%
Respiratory disorders	2.2%	0.7-3.7%

Sixty eight percent of the breeders reported during their breeding career of having at least a single case of dystocia with their mares. The mean dystocia incidence was 5.2% (CI 2.6-7.8%). The mean incidence of premature placental separation was 0.82% (CI 0.26-1.39%) and was observed by 8/22 breeders surveyed. Six of the breeders reported having mares with retained placenta. The mean incidence of retained placenta across the breeders surveyed was 1.4% (CI 0- 3.6%).

### Congenital defects

The lay literature implies that the Miniature horse population has a high level of congenital defects compared to other horse breeds. The mean incidence of dwarfism in the sample population was 0.7% (CI 0.11-1.28%). The mean incidence of sow and parrot mouth was 1.22% (CI 0.00-2.43%) and 0.45% (CI 0-0.84%) respectively. Eleven of the 22 breeders reported having foals

excluded from the studbook due to dwarfism or congenital disorders such as sow or parrot mouth.

Late descent of the testicles is perceived to be a problem in the Miniature horse breed by owners. The mean incidence of cryptorchids (males whose testicles failed to descend) in the sample population was 1.34% (CI 0.3-2.4%). The mean incidence of patella luxation/subluxation or upward fixation of the patella in the foals was 2.91% (CI 0.36-5.5%) within the sample population. The mean incidence of respiratory disorders was 2.2% (CI 0.7-3.7%). These included signs indicative of collapsed trachea, and coughing and the passing of milk from the nostrils (indicative of cleft palate).

### DISCUSSION

A limitation with the present study was the small sample size and the non-random selection of the breeders that were interviewed. It is estimated that there have been 6,052 Miniature horses registered in NZ with 677 new registrations in 2004. Our sample therefore represented 7% of the Miniature horses; the foal crop represented 21% of new Miniature horse registrations and 4% of the estimated 500 registered owners of Miniature horses.

The sample size of the survey, and subsequent conversations with Miniature horse breeders, indicate that the results reported in this paper should reflect the true population incidence of the disorders. However, caution should always be applied to retrospective data that relies on owner recall and diagnosis of disease conditions.

The number of Miniature horse broodmares kept by a breeder was large in comparison to the 1 to 2 broodmares kept / owned by the "typical" NZ Thoroughbred or sport horse breeder (Rogers and Wickham 1993). The higher average number of broodmares kept by the miniature horse breeders may be a reflection of the greater stocking rate possible with the Miniature horse breed.

The majority of the breeders used hand serving to cover the mares, or hand serving and followed up with the stallion running with the mares. Currently the use of artificial insemination is not permitted within the NZ stud book, though it is permitted within the American-based breed societies. Regulations on the use of artificial insemination in NZ may change as demand for American genetics and smaller sized animals increases.

The strong reliance on blood testing for pregnancy diagnosis may reflect the unwillingness of owners and veterinarians to use transrectal

ultrasonic examination in such small animals due to the risk of rectal perforation. It has been suggested that blood tests for measurement of oestrone sulphate and equine chorionic gonadotrophin should be performed in tandem in Miniature mares to improve the accuracy of pregnancy diagnosis (Foristall et al. 1998). It was not determined what tests were used by breeders in the survey to confirm pregnancy diagnosis, and data on apparent fetal loss in this survey should be viewed with caution. Some owners may have misclassified barren mares as mares who suffered from apparent fetal loss.

The use of non-return rates at 28 days for pregnancy diagnosis can potentially result in a large number of false-positive results, as it relies on the owner not observing oestrus behaviour in the mare. Conception rates in Miniature horses have not been reported. In Shetland pony mares in The Netherlands non-return rates at 28 days for pregnancy diagnosis ranged from 67 to 74%, with large variation due to individual stallions and management techniques (van Buiten et al. 2003). Foaling rates for Shetland ponies ranged from 48 to 80%, with a strong influence of management system (van Buiten et al. 1998). In larger breeds with greater commercial pressure to produce a live foal such as the English Thoroughbred, end of season conception rates of 77% (Morris and Allen 2002) were similar to that reported here for the NZ miniature horse.

The incidence of apparent fetal loss was low (11%) and comparable to other large breeds. In a population of Norwegian trotters (Klemetsdal and Johnson 1989) reported that the percentage of aborted pregnancies was 9% and the incidence of abortion was significantly affected by the age of the mare and her inbreeding coefficient. Hemberg et al. (2004) estimated that pregnancy loss in Thoroughbreds was 12.5%. These studies would indicate that at least within the NZ population the Miniature horse does not have an abnormally high rate of pregnancy loss. However, the fetal loss results of the current study must be viewed with caution, as relatively few owners used reliable tests to determine early pregnancy, and those that were diagnosed positive as a result of ultrasonographic examination or blood tests were only based on one examination. In the current study the stage of gestation at which pregnancy was positively diagnosed was not determined. For owners using transabdominal ultrasonic pregnancy diagnosis, and/or serum oestrone sulphate early pregnancy diagnosis is not possible as these tests are usually performed at greater than 100 days gestation. Thus, owners would not be aware of pregnancy loss prior to 100 days gestation.

In the present survey the incidence of dystocia was comparable to that of Thoroughbred mares, and lower than that of draft mares (4% and up to 10% respectively, Vandeplassche 1993). Shetland ponies have an incidence of about 8% dystocias, mainly caused by a large skull (Vandeplassche, 1993). However, in the population of Miniature mares studied the influence of small mare size and the dome-shaped head of the foal on dystocia rates appear small. In the present study the incidence of retained fetal membranes was low (1.4%) compared to 10% after normal deliveries in Standardbreds (Provencher et al. 1988), and 54% after normal deliveries in Friesian horses, (Sevinga et al. 2004a), a breed with a high level of inbreeding.

The level of dwarfism and congenital abnormalities in the population surveyed was much lower than anticipated. Confidentiality of responses was guaranteed so it was unlikely that breeders were guarded or conservative in their comments and responses to the questions regarding dwarfism and congenital abnormalities.

A dwarf foal is identified as an individual that displays one severe dwarf abnormality or two minor dwarf abnormalities. Within the miniature horse population it can be difficult to identify a dwarf foal as some individuals display one or more typical characteristics of dwarfism. Dwarf foals can be the product of two phenotypically normal parents leading some breeders to attribute dwarfism to a single or few recessive gene(s). In the USA the focus on reducing height has seen the extensive use of some sires that had obvious signs of dwarfism. These sires appear in the pedigree of many miniature horses. A number of breeders mentioned they were always mindful of dwarfism when planning matings and took care to avoid breeding individuals that were too closely related.

## CONCLUSION

The reported low incidence for dwarfism and congenital abnormalities may reflect the care taken by the NZ breeders to avoid intentionally inbreeding, and also that the NZ population is likely to still be relatively heterozygous due to the recent formation of the breed and the variation in foundation stock. The relatively heterozygous nature of the current breeding population may indicate the NZ population has not yet undergone intensive inbreeding to fix the type and size of the NZ Miniature horse. In the USA, where the breed originated, the studbook was formed in 1978 and there has been a rapid increase in popularity of the breed. Associated with the increase in popularity

has been a drive to fix the smaller size and type of horse. This rapid expansion of the American population and drive to fix type may lead to the anecdotally reportedly high rate of reproductive and congenital disorders in the USA Miniature population compared to the low levels observed in the apparently heterogeneous NZ Miniature horse population.

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