The Reproductive Life

of the

New Zealand Standardbred Mare

Research Study Project

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Abstract

In the last years, the breeding industry of Standardbreds has decreased dramatically. In this study the selection of mares was investigated based on their sire's stud fee, and comparisons were made between three generations. For 9 Standardbred sires, the fillies of the '98/'99 season and their dams and granddams were investigated.
In the fillies by the expensive sires (>$3.000 stud fee) the numbers of fillies bred, raced and exported was greater than those of less expensive stallions. These foals also had more expensive sires in their ancestry. Mares by expensive sires started breeding earlier in life. Mares by cheap (<$2.000 stud fee) sires tended to be of lower parity than more expensive horses. The results suggested strongly that the less expensive horses were being culled from the breeding herd.
When comparing the generations it was noted that the number of mares that raced stayed the same. There was no difference in the age at which each generation started breeding. The parity of the investigated mares increased with every generation. With a foaling/serving ratio scatter plot a form of selection became evident with the dams and granddams, such a selection was not yet found with the '98/'99 fillies.
Further research on this subject is needed, and a method to obtain less biased results should be found.

Introduction

There have been few studies published examining the Standardbred breeding or racing production system. The majority of population based studies on reproductive efficiency in the horse have focused on the Thoroughbred. However, the breeding system of Standardbreds differs from that of the Thoroughbreds in that the use of artificial insemination and embryo transplantation is allowed in the latter. [2]

In 2004, about 4500 broodmares were active within the Standardbred industry.[2] In that same year, there were 135 active sires. [6] There is significant commercial pressure on a sire to generate progeny that are successful at an early age with half of the Standardbred sires no longer active after 4 years at stud. The fertility and the amount of mares covered per year of the remaining sires stays stable until the 17th year at stud, when it decreases.

Similar to the Thoroughbreds, the Standardbred industry has undergone a dramatic decrease in actively breeding animals. In the seasons '89-90 to '04-'05 the number of New Zealand broodmares decreased by 36%, and the number of life foals decreased by 40%. The number of active New Zealand sires decreased from around 150 to approximately 60. However, there appeared to be more efficient use of the reduced number of active sires with the average sire covering 1.45 more mares per year in the mentioned period. [2]

This drastic decrease in the numbers of actively breeding horses gives rise to questions about the selection of these horses. Are the breeders becoming more ruthless in the culling of their mares?

And if so, on what grounds do they decide a mare is fit for breeding? Before we could answer these questions, we should first look into the fertility of the standard mare.

The ideal broodmare manages to produce a foal every year. To achieve this, a mare should be pregnant again within 25 days of the start of the mating season, or within 25 days post foaling. If a mare fails to conceive within the optimal 25 day window over several seasons, chances are that eventually she has to skip a season altogether. This conception interval can be lengthened by failure to conceive, early embryonic death or fetal loss. The interval tends to increase with mare age, and mares over 18 years have a significantly lower success rate in all stages of pregnancy. Also, mares that need to be mated multiple times during one season are less likely to produce a life foal. [1]

The quality of a foal depends on many factors, but a positive association was found between the height of the withers and hip and the lifetime earnings, Standard Starts Index and winning percentage. Foals tend to get larger with increasing parity with the greatest increase in foal weight between the first and the second foal, suggesting a sort of 'priming' of the uterus.[1] According to previous studies the heaviest foals are from multiparous mares aged 10-15 years. [4] However, there is also anecdotal evidence that a mare's third foal is usually the best. At the age of about 16 years mares tend to keep the weight of their foals constant. This is most likely due to degenerative changes in the opposing endometrium, compensated by the high chorionic volume in this group. [3] We believe the culling of broodmares is largely based on a mare's fertility. Out hypothesis is that if a mare fails to produce a certain number of foals over several coverings, she will usually be culled from the breeding herd.

Lineage is another factor in selection. It has been suggested that the life foal rates of offspring of expensive stallions may be greater due to more intense management this foals may receive. [1] It was also identified that the stud fee of a potential broodmare is a major factor in the decision to breed from her.[5] Therefore we hypothesize that foals of the more expensive stallions start breeding earlier than the foals of cheaper stallions. In contrast to the offspring of cheaper horses, foals from expensive horses do not need to prove themselves on the racecourse. Indeed, we find it plausible that breeders will spend more time and money on the offspring of an expensive stallion than they would on the progeny of a less expensive one. This has led us to the hypothesis that such preference would reveal itself in several ways. We believe that a larger portion of fillies of expensive sires will enter the racing, compared to those of less expensive sires. We expect the same to be true for entering into the breeding herd. We also believe that fillies from expensive stallions will be exported more than other foals. Furthermore, we find it plausible that fillies of less expensive stallions will be more often sold as hacks. A hack is defined as a horse that is given away or sold for non-breeding and non-racing purposes. Because the breeding industry has shrunk considerably over the past few years we believe that fillies by expensive sires are more likely to be from dams and granddams that were in turn by the more expensive sires than the fillies of lesser stallions.

It is plausible that the expensive stallions have larger book sizes than cheaper stallions. As mentioned before, we expect that mares from more expensive sires start breeding earlier, while others have to prove themselves on the racetrack. Consequently, we believe that expensive sires will mostly serve mares that are in their early breeding life (foal parities 1-4) and the cheaper mares that have proven themselves worthy for breeding (foal parity ± 8 or up)

In this study we will analyse the online Standardbred Database to test the hypotheses we have described in this introduction.

Material and Methods

Stallions

The stallions were categorised by their stud fee dividing them in the cheap, medium or expensive category, respectively <NZ $2000, $2000-$3000 and >$3000. From the book "1999-2000 New Zealand Standardbred Sires" we selected nine stallions; three from each category which covered more than 15 mares each.

A variation was found in the manner of recording between the stallions season's Fertility Statistics and the list of the progeny of the same year. Therefore we decided not to use the information of the Fertility Stats in this study. We took the progeny born in 1999 (in other words, from breeding season 1998/1999) from the New-Zealand Harness Racing website, www.hrnz.co.nz, using the Horse Enquiry. The gathered information was imported to MS Excel 2007. The colts were discarded.

Fillies

Data on the fillies own performance and breeding history were obtained from the New Zealand Harness Racing online database. For the fillies data were collected on the parity of the fillies, if they had been exported, if they had raced, entered breeding, and if they had been given away as a hack. Of the fillies that started breeding data were collected on the age of the filly at the first season of breeding, the number of coverings number of positive pregnancy tests (PPT) and foals. Also the 'no returns' were listed. The PPT was the total number of coverings less the coverings identified as 'Missed' and 'No Return', (where a mare was covered, but failed to conceive). Differences between PPT and number of foals were due to abortions (slips) of the foetus after a positive pregnancy test. Foals that died at or shortly after birth were counted as a full term delivered foal. If a mare had died after a covering it was counted as "Covered but Missed".

If a filly had been exported to Australia, we searched for the breeding and racing records on the Australian harness Racing website:
(http://www.harness.org.au/index.cfm?p=f&id=/ausbreed/reports/hraonline.htm)

Fillies exported to other countries were given a positive racing status if raced in New Zealand, or an unknown racing status if not. To quantify reproductive efficiency the Ratio of foals/servings and PPT/servings were calculated.

Dams and granddams

Breeding and racing history of the Dams and granddams were retrieved using the previously mentioned online databases. . The sires of both dams and granddams were listed and categorised into cheap, medium and expensive according to available studbooks and expert opinion.

The 'No return' outcomes were listed separately, but it was assumed it meant no foal was born that year.

Analysis

Data were collated and edited within MS Excel (Microsoft corp, Redmond, Wa, USA). The data were then imported in SPSS 17.0. Data were analysed using either a General Linear Model test, a Chi Square test or a Survival Analyses. For all analysis significance was set at $p<0.05$

Results

4197 Mares were covered in the 1998/1999 season, resulting in 3049 life foals. There were 75 stallions at stud, resulting in an average book size of 55.96 per stallion. We failed to retrieve the stud fees of 22 of the stallions. Of the remaining stallions, 45% were categorised as cheap, 34% as medium and 21% as expensive.

Table 1: Total Standarbred sires standing '98/'99

	Cheap (<$2.000)	Medium ($2.000- $3.000)	Expensive (>$3.000)	Unknown	Total
Sires in category	24	18	11	22	146
Mean mares covered	46	69	109	31	221
Total mares covered	1070	1245	1204	678	4197
Total live foals	776	929	884	460	3049

Cheap sires covered significantly fewer mares per stallion than expensive sires (P=0.035). However, they seemed to make up this difference by their number in the population. The differences in number of servings between cheap and medium and those between medium and expensive were not significant.

1999 born Foals

Export

There was a significant effect of sire category on the proportion of 1999 born foals that were exported. A greater proportion of the fillies sired by expensive sires were exported than those sired by cheap stallions (11.3% and 28.8% respectively, P=0.01). 20.4% of fillies by medium stallions were exported which was not different to the fillies sired by either cheap or expensive sires.

Hacks

A lower proportion of the foals by expensive sires ended up as hacks than foals sired by to cheap and medium bred horses P=0.05 and P=0.009 respectively.

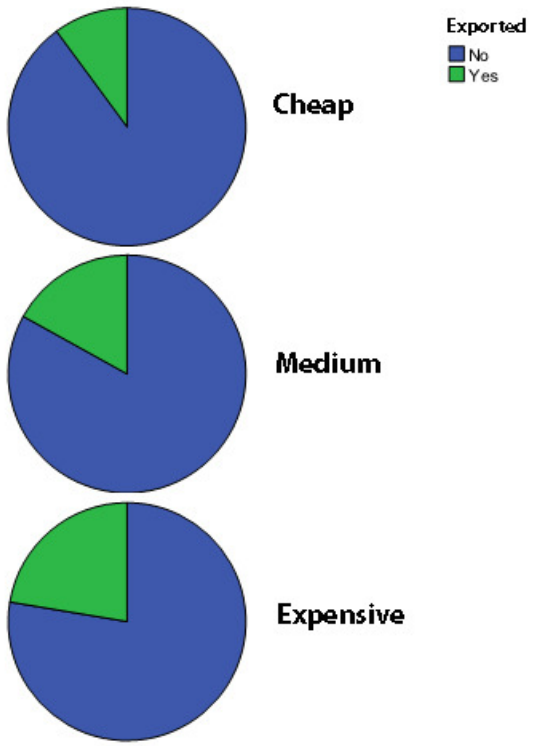


Figure 1: Exported Fillies per Sire Category

Raced Fillies

A significantly higher percentage of mares sired by an expensive sire entered racing than those sired by both medium and cheap sires (P=0.000 and P=0.005 respectively). There was no significant difference between the percentage of mares from cheap sires and those frommedium sires entering racing.

Bred Fillies

There were significant differences between the percentages of foals that went into the breeding herd per sire category. The percentages for cheap, medium and expensive sires were respectively 36%, 51% and 76%.

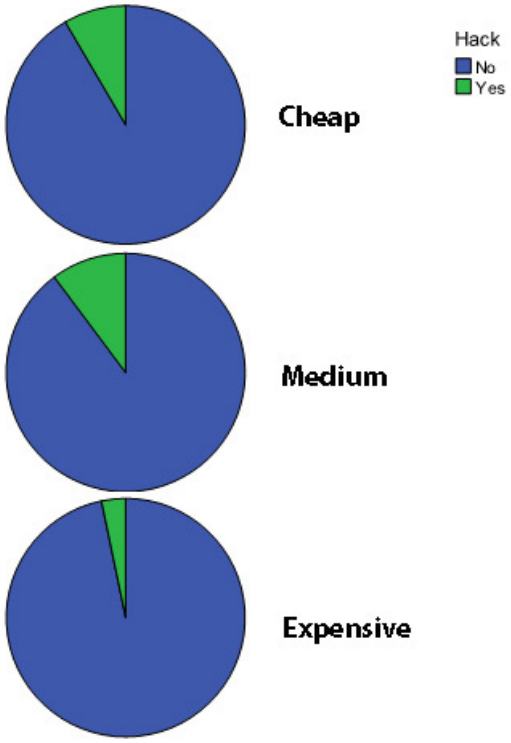


Figure 2: Fillies turned Hack per Sire Category

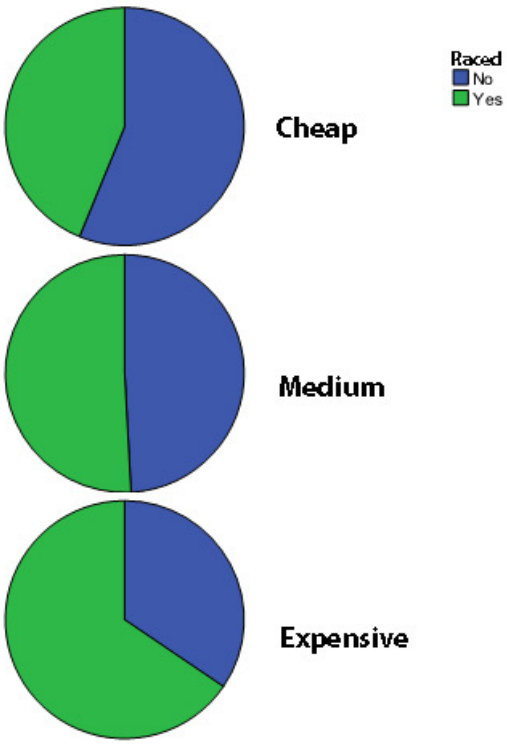


Figure 3: Raced Fillies per Sire Category

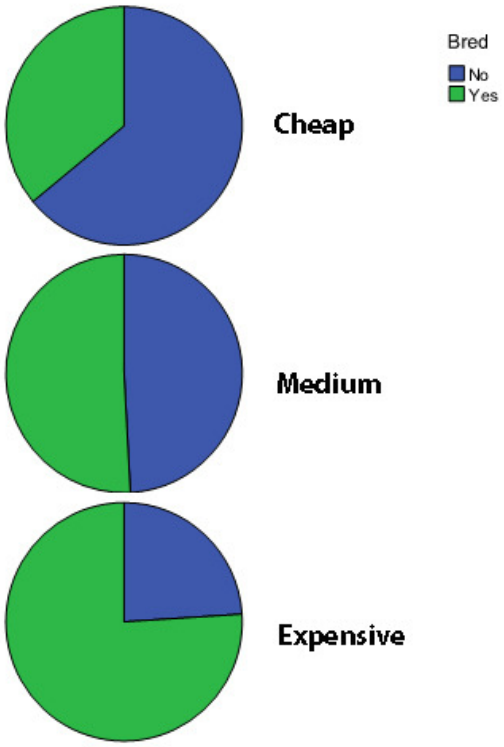


Figure 4: Bred Fillies per Sire Category

Age at Start Breeding

Mares by expensive sires started breeding considerably earlier than mares by medium and cheap sires. (P=0.001) There was no significant difference between the mares by medium sires and the mares by cheap sires. (P=0.768)

Parity

It looked like more of the cheaply bred mares were first parity. However, this difference was not significant. (P=0.594 and P=0.993 for medium an expensive bred foals respectively) The distribution of the parity of these foals was not significantly different.

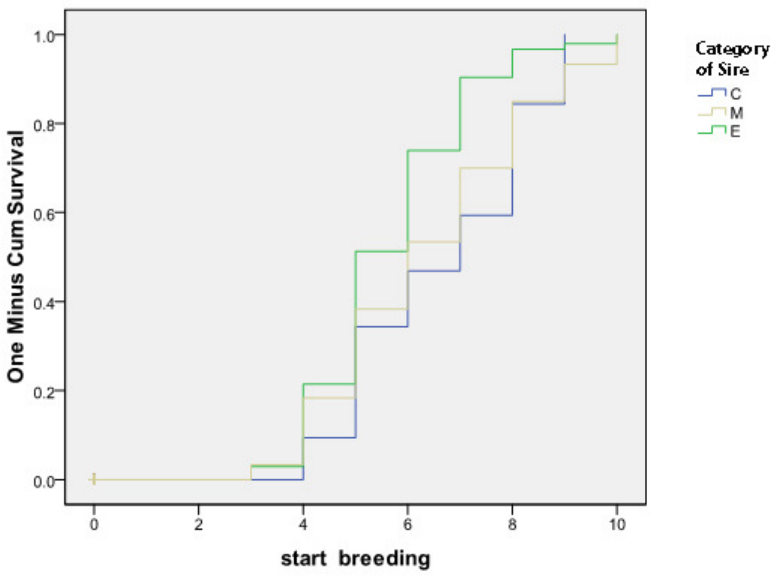
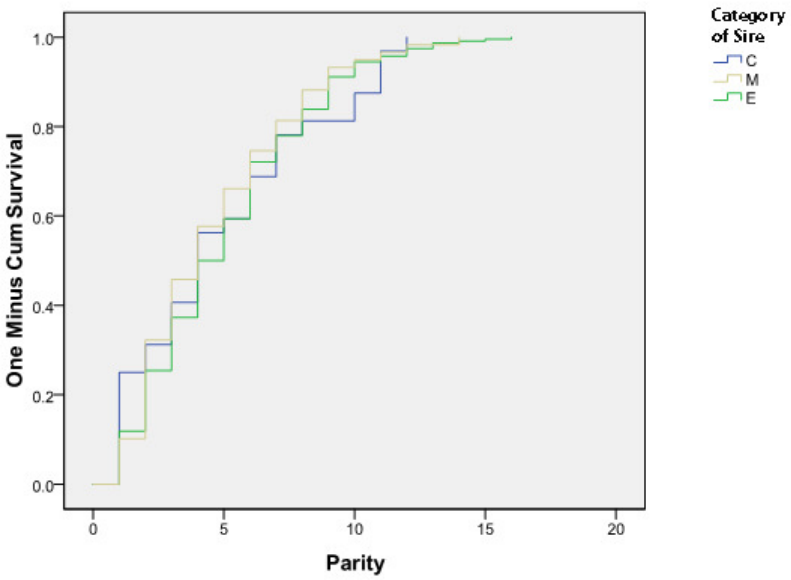


Figure 5: Survival Analysis of Parity of Fillies



Note: To success-fully compare this data, we only used the Fillies with a breeding record

Figure 6: Survival Analysis of Age at Start Breeding of Fillies

Racing vs. Breeding

Most of the mares by cheap sires were neither used for breeding nor for racing. However, according to the chi-square test the differences in this distribution were not significant. (P=0.077)

The distribution in the Medium crosstable was significantly different, with most mares both bred and raced, or neither bred nor raced.

In the cross table of the mares by expensive sires, the difference was significant. Most mares were both active in breeding and racing.

Table 2: Racing vs. Breeding 1999 Fillies

Category of Sire			Bred		Total
			No	Yes	
Cheap	Raced	No	36	14	50
		Yes	21	18	39
	Total		57	32	89
Medium	Raced	No	40	18	58
		Yes	18	42	60
	Total		58	60	118
Expensive	Raced	No	33	75	108
		Yes	42	163	205
	Total		75	238	313

All Generations

Note: To compare similar populations, we only included 1999 fillies with a breeding record in the following results

Hacks

Throughout all generations, there was no significant difference in the number of hacks between the sire categories. There was a trend towards less hacks (P=0.056) in foals by expensive sires compared to foals by medium sires.

Raced

There was no significant difference between the numbers of animals racing per generation. However, there was a trend in that a smaller number of granddams had raced compared to the 1999 foals and their dams (p=0.1 and p=0.07 respectively)

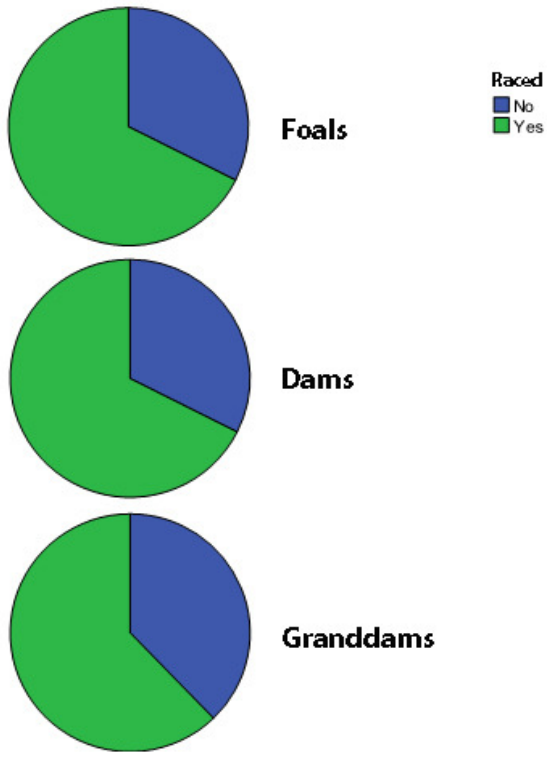


Figure 7: Mares Raced per Generation

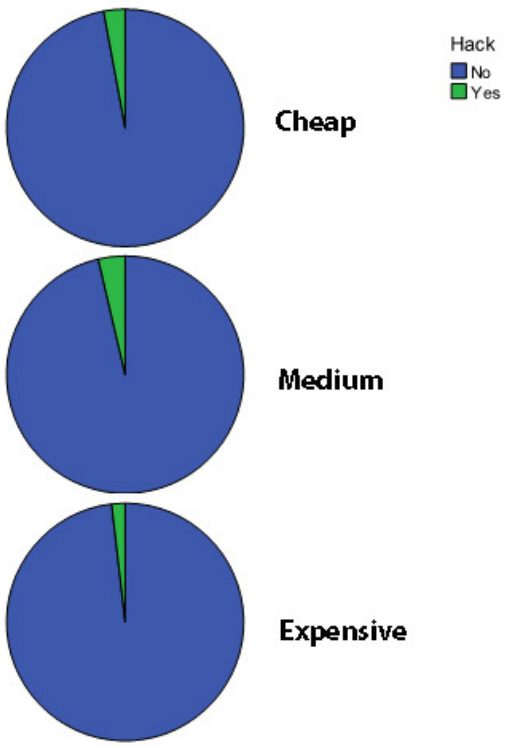


Figure 8: Hacks in All Generation per Sire Category

Age at Start Breeding per Category

Just like in the 1999 fillies, in the complete population mares by expensive sires started breeding considerably earlier than mares by medium and cheap sires. (P=0.0001) There was no significant difference between the mares by medium sires and the mares by cheap sires. (P=0.380)

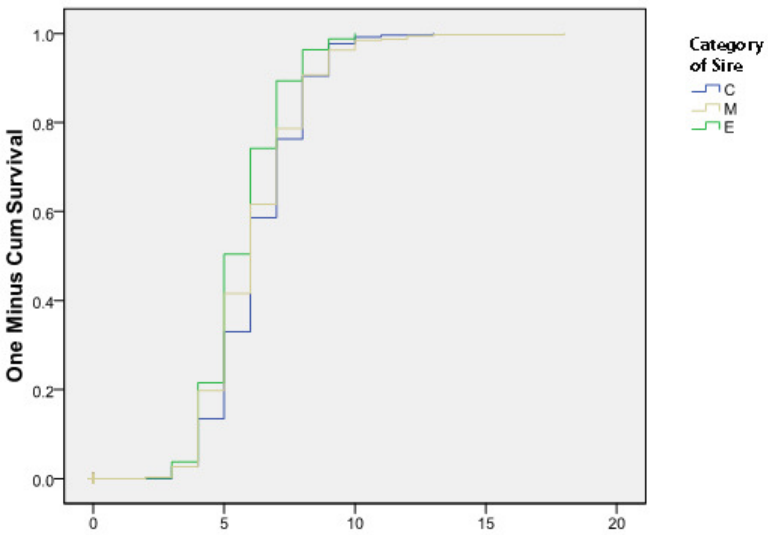


Figure 9: Survival Analysis of Age of Start Breeding in All Generations

Age of Start Breeding per Generation

The age at which the mares begin breeding was not significantly different between the generations. (Between generations foals/dams, foals/granddams and dams/granddams P=0.902, P=0.0.607 and P=0.47 respectively)

Parity of Mares per Category

In the whole population there was a significant difference between mares by a cheap sire and mares from both medium and expensive sires (P=0.004 and P=0.000 respectively) The parity of cheaply bred mares was significantly lower than the parity of the other mares. There was no significant difference between mares by medium and expensive sires. (P=0.839)

Parity of Mares per Generation

The parity of the foals, dams and granddams were significantly different. (P=0.0001) Granddams had the lowest parity, and the foals had the highest.

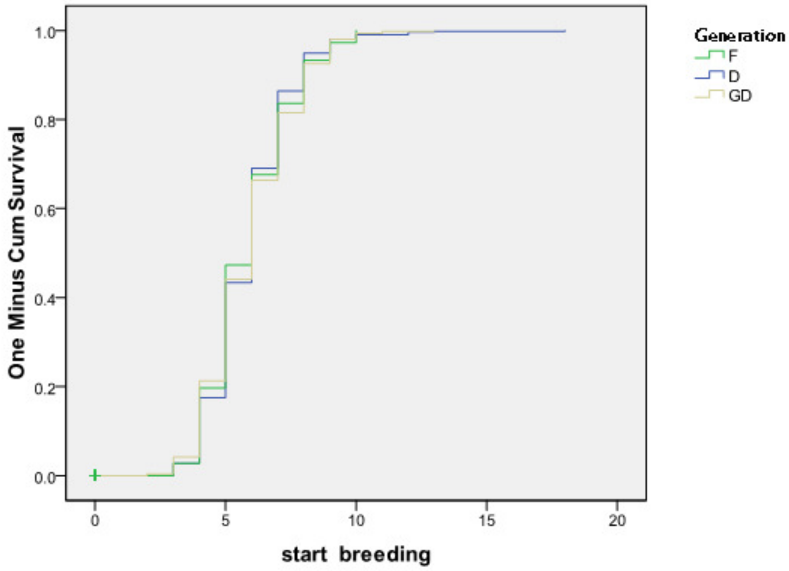


Figure 10: Survival Analysis of Age of Start Breeding per Generation

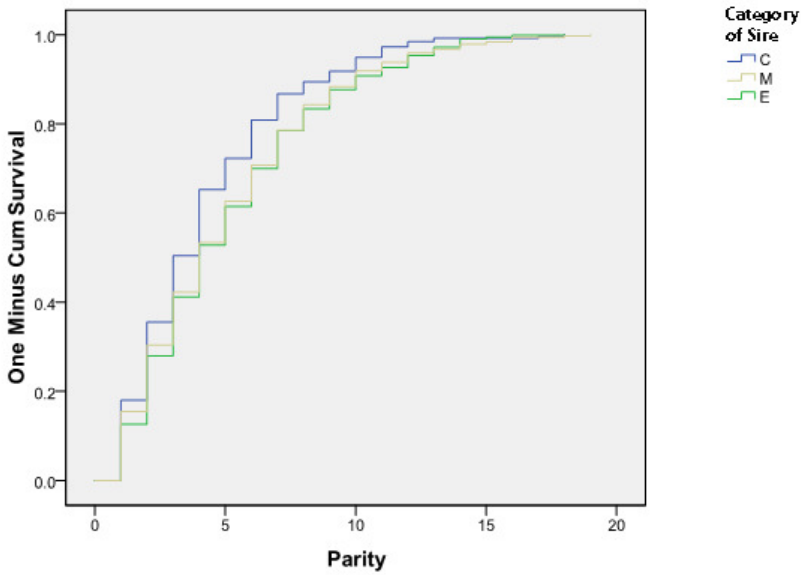


Figure 11: Survival Analysis of Parity of Every Generation

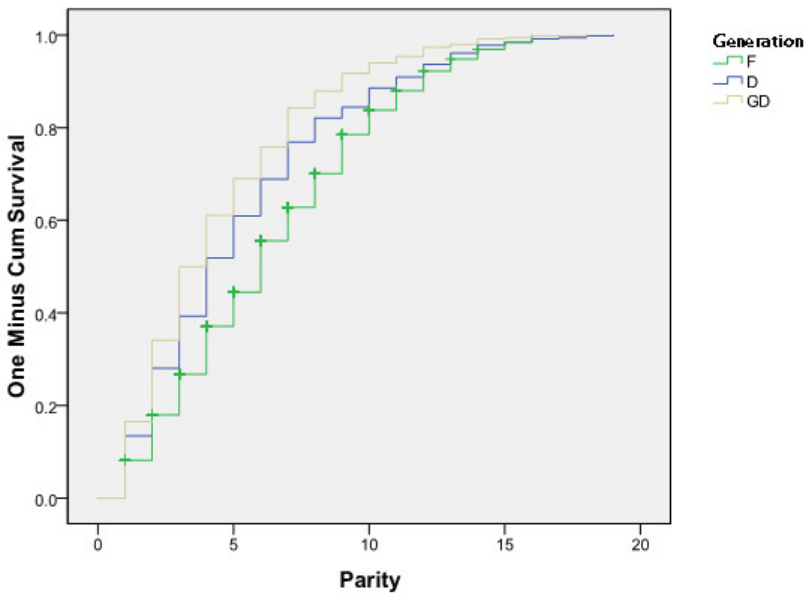


Figure 12: Survival Analysis of Parity per Generation

Ancestry of the 1999 Fillies

In the overall population there was a significant difference in the ancestry of fillies by cheap and fillies by expensive sires. (P=0.000) Fillies by expensive sires had considerably less cheap sires in their ancestry and significantly more expensive. Differences between fillies by medium sires and those by either cheap or expensive sires were not significant.

In the dam's sires (the fillies' grandsires), there was a significant difference between cheap and medium (P=0.041) and cheap and expensive (P=0.001) There was no significant difference between medium and expensive.
Both expensive and medium bred fillies had significantly more expensive grandsires.

In the granddam's, there only was significant difference between fillies by medium sires and fillies by expensive sires (P=0.00). Fillies by medium sires had less expensive great-grandsires than both the cheap and the expensive, although the difference between the number of expensive sires in the cheap and medium bred horses was not significant. (P=0.984) The difference between cheaply and expensively bred horses was P=0.125.

Foaling/Serving Ratio per Generation

The scatter plot of the 1999 foals looked quite randomly distributed, and it was hard to spot a trend. In the dam scatter plot, the foaling/serving ratio seemed to augment with the increasing number of servings. A similar pattern could be found in the granddam plot.

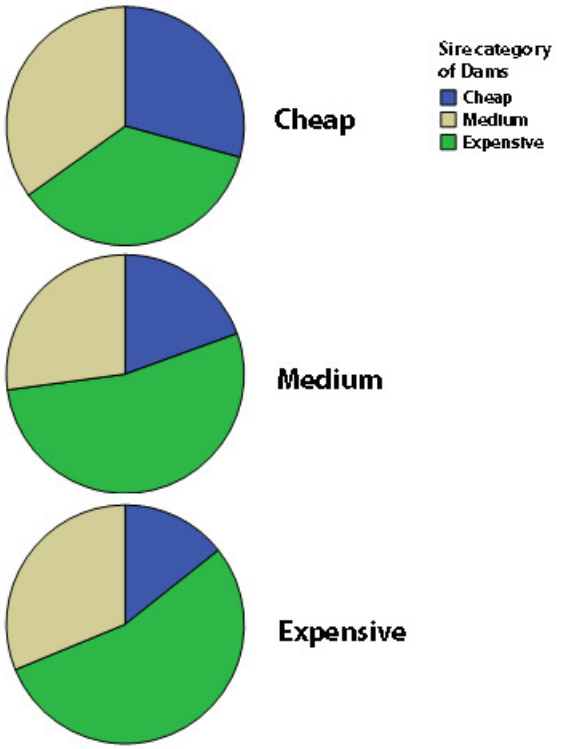


Figure 13: Sires of Dams per Category of Sire of Fillies

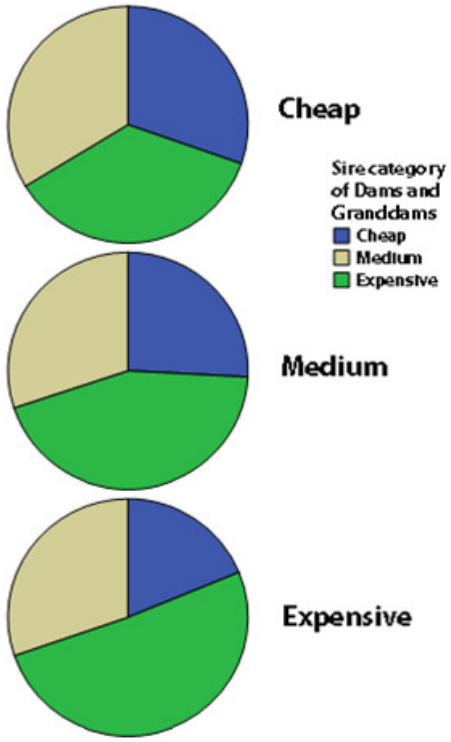


Figure 15: Sires of Dams and Granddams per Category of Sire of Fillies

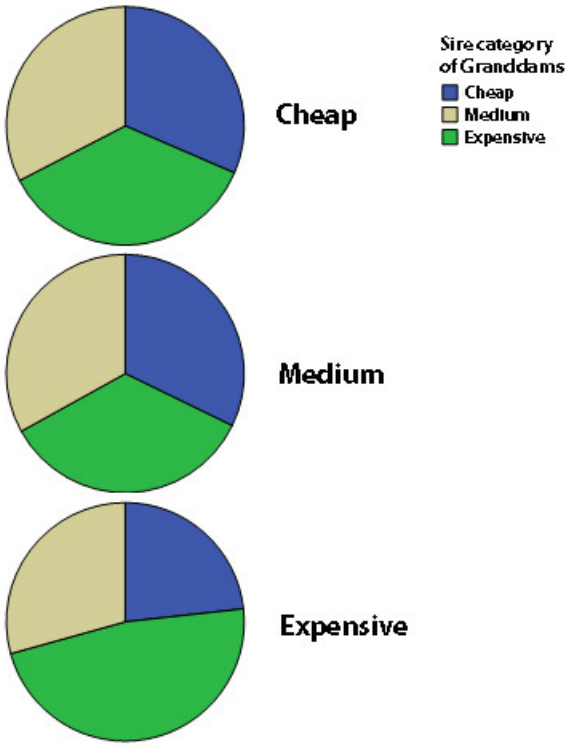


Figure 14: Sires of Granddams per Category of Sire of Fillies

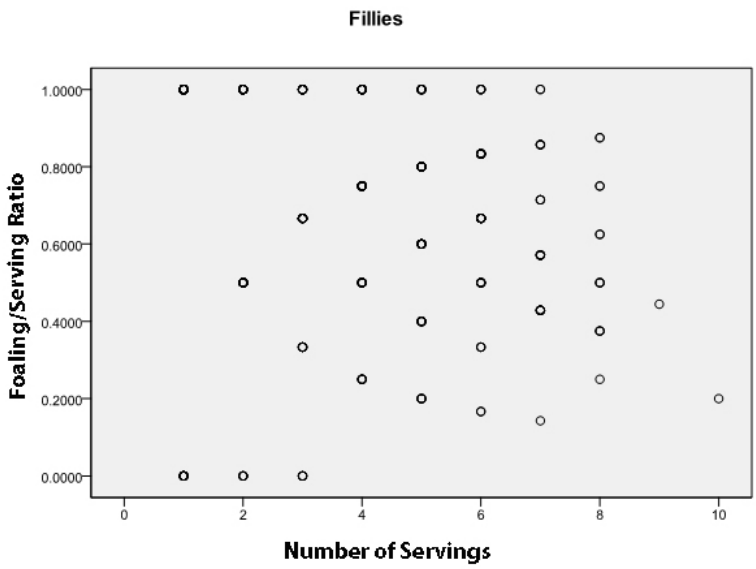


Figure 16: Foaling/Serving Ratio of 1999 Fillies

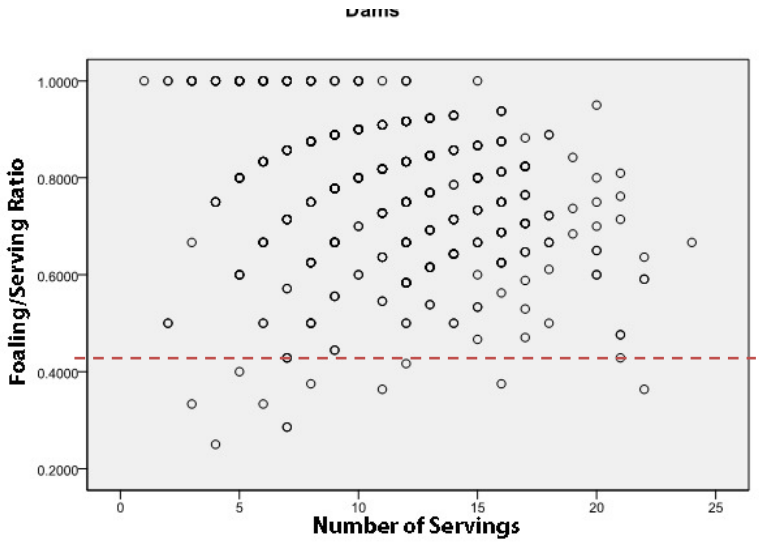


Figure 17: Foaling/Serving Ratio of Dams

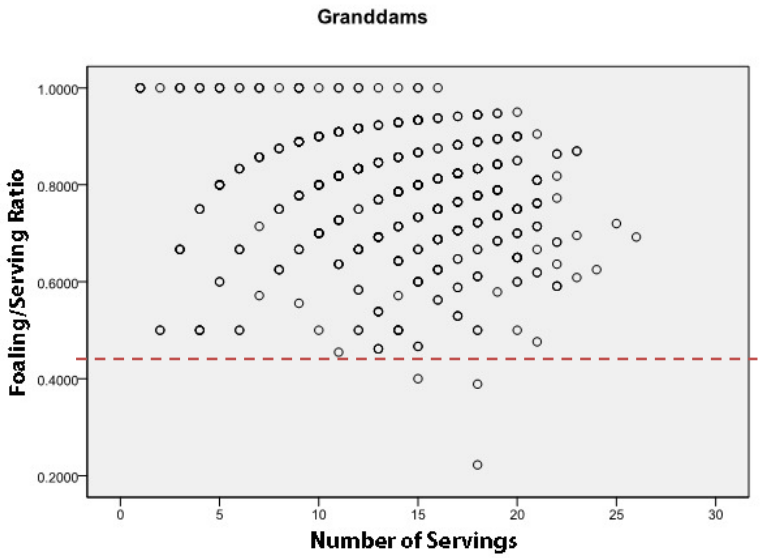


Figure 18: Foaling/Serving Ratio of Granddams

Discussion

Fillies

Regarding the export of foals, it seemed that our hypothesis was correct; fillies by expensive sires were exported more. However, the difference was only significant between cheap and expensive. Foals by medium priced stallions held the middle ground. It is plausible that the number of exports was positively correlated with the stud fee of the foal's sire.

Our hypothesis about racing was confirmed by the data as well. More of the foals by expensive sires entered racing. Our theory is that breeders entered the mares into the racing to earn back the substantial stud fee. The stud fees of sires were mostly based on their own (or their relatives') performance on the racecourse. It is therefore also plausible that more foals by expensive sires entered racing, simply because they were deemed to be more talented.

In regard to the number of foals that went into breeding, our hypothesis was correct. The majority of foals by an expensive sire entered into breeding, and this number decreased with the sire's stud fee. This strengthened our theory that the foals by cheaper sires were being culled. We also find it plausible that the breeders wanted to compensate for the hefty stud fee by producing (and possibly selling) foals from the mare.

Regarding to the Racing vs. Breeding table, we have come to the following conclusions:
Most foals by cheap sires were not active in breeding, which strengthened our theory that these horses were being selected out. About half of the horses that did breed had a history of racing. This may support our theory that cheaper mares had to prove on the racecourse that they were worthy of breeding.
This theory was strengthened more when we look at the cross table of the medium bred mares. Of the horses that were active in the breeding herd, 70% had a racing history as well. 30% of the animals that raced did not go into the breeding herd. Perhaps these were the mares that disappointed on the racecourse and consequently were selected out.
Only a small portion (11%) of the expensive bred foals are were inactive in both breeding and racing. Almost half (52%) of foals were active in both sections.

All Generations

It was hard to conclude anything from the numbers on the number of hacks in both the 1999 fillies and the whole population. It would seem that the foals from the expensive sires were indeed less prone to become hacks. However, the numbers were a lot less than we expected. This led us to the theory that the information might have been unreliable because of low priority and bad bookkeeping on this particular subject.

In both the 1999 fillies and the complete population, the offspring of expensive sires started breeding earlier than the offspring of both cheap and medium sires. This supported our theory that mares by expensive sires were bred solely because of their sire's stud fee, and consequently did not have to prove themselves on the racecourse first.

It would appear that in the whole population, cheaply bred mares had a lower parity. This did not correspond to our hypothesis. This difference might be explained by less variance in the cheap group due to the fact that there were overall less cheaply bred mares. As stated in the introduction, the first foals a mare produces have a sort of 'priming' effect on the uterus. These foals often have low

bodyweight. Another explanation for the situation found in these graphs might be the fact that breeders were unwilling to spend a lot of money on the stud fee for these lighter foals.

The following could be found in the ancestry data. In the overall generation and the dam's sires, a positive correlation between stud fee and the number of expensive sires in the ancestry became evident. The results from the granddam's sires (the foals' great-grandsires) seemed slightly different, in that the foals by medium sires had the smallest number of expensive great-grandsires. However, judging from the numbers we assumed that this is probably a matter of chance.

It was interesting to see how mares of medium sires behaved in the study. Mostly they took the middle ground in the analyses, leaning to either cheaply bred mares or expensive mares. Regarding to export, racing, breeding and the age at the start of breeding these mares leaned more towards the mares by cheap sires. The same was found for the parity of the 1999 fillies. Remarkably, when it came to the parity of mares in the whole population, the mares by medium sires were leaning more towards those by expensive sires. Perhaps the breeders of the dams and granddams were less willing to pay a medium priced stud fee for priming the uteri of broodmares. Regarding the sires of both dams and granddams, the foals by medium sires once again leaned more towards the fillies by cheap sires. In the sires of the dams alone however, the medium bred mares were closer to those of expensive breeding. This was probably compensated by the fact that in the granddams of medium bred mares, the number of expensive sires was actually smaller than in the granddams of cheaply bred mares. As stated before, this might have been a matter of coincidence.

Relating the Generations

Although there was no significant difference between the number of mares raced, it would seem that a smaller number of granddams have raced as well as bred, compared to the 1999 foals and their dams. It is possible that granddams were used more intensively in the breeding sector than mares nowadays. Possibly, the means of determining pregnancy were less reliable in the time of the granddams, which caused the breeders to monitor them more intensively, leaving less time to race. It is also possible that the records of the granddams were less reliable because of lacking bookkeeping in that period of time.

We suspected the age of the foals at the start of breeding would be slightly lower in comparison to that of the dams and granddams. We hypothesised that foals would start breeding earlier because of the selection on more expensive sires in their ancestry, and thus we expected they did not have to prove themselves on the racecourse as much as the previous generations. The results, however, yielded no evidence of this. It seems that through the generations, the age at which the mares start breeding stayed approximately the same.

We did not have a satisfying explanation of the results of the comparison of the parity of mares. Possibly the earlier records were less reliable than the records nowadays. The older records might have only registered mares that were known to have bred or raced.

Looking at the dams foaling/serving ratio plot, around 10 servings we noticed that, with some exceptions, all mares had a foaling/serving ratio of 0.45 or higher. It would seem that horses that did not manage to attain this ratio within 10 attempts were culled from the breeding herd.

However, such a trend was not evident in the 1999 foals, presumably because this generation has not had the chance to have more servings. It is possible that a similar effect as with the dams will appear, should we repeat this research in ten years.
Judging by the granddam plot it looked as if all the granddams, except for three, had a foaling/serving ratio of 0.45 or over. We found it implausible that the granddams fertility was so much higher.
It is possible that by working back from the foals, we created a bias towards the more fertile granddams; the more foals a granddam has had, the more chance that we picked one of her grandfillies.
It is also possible that the bookkeeping of missed coverings or slipped foals was not kept very well in that time.

Regarding the study

Because of the way of selecting the mares we worked with, the image of the dams and granddams wasn't representative for the whole mare population of their generations. By working backwards from the foals, we selected only the dams and granddams that have had at least one foal, and thus we did not take the non-breeding mares of that generation into account. Therefore, this study only assessed the culling of the mares that actually had a chance at stud. Our theory was that most mares that get a chance at stud have to prove themselves worthy first, either by stud fee of their sires or by performance on the racecourse. By selecting back from the 1999 fillies we may therefore have caused a bias in the used population towards the 'better' mares.

To avoid such a bias in next studies, it is wiser to make a selection from mares born around 20 or 30 years ago, and work forwards from there. However, in such a study it will be impossible to assess the parity of the next two generations. Also, by choosing the foals to research, a bias may appear towards a certain parity, and consequently perhaps the category of the sire of said foal.

In following researches, more thought should be given to the ideal way to subjectively investigate the data of the Standardbred database.

Conclusion

Large differences were found between the three sire categories. Mares by expensive sires were exported, raced and bred more than those by cheap and medium sires. Expensively bred mares started breeding younger, strengthening our hypothesis that these mares do not need to prove themselves on the racecourse. Foals by expensive sires have more expensive sires in ancestry. The parity of foals by cheap sire was found to be lowest.
The number of broodmares that enter racing remained equal through generations, as did the age at which the mares start breeding. Inexplicably, the parity of the mares seemed to increase with every generation.
In the foaling/serving ratio of the dams a form of selection became evident. Such selection was not found in the '99 foals, possibly because these fillies have not been at stud for long enough periods. The method of selection we used for the mares may have caused bias in the dams and granddams towards the better mares. Further research needs to be done on this subject.

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Appendix – Tables

Table 3: Exported Fillies

		Exported		Total
		No	Yes	
Category of Sire	Cheap	80	9	89
	Medium	98	20	118
	Expensive	243	70	313
Total		421	99	520

Table 4: Hacks in 1999 Fillies

		Hack		Total
		No	Yes	
Category Of Sire	Cheap	76	7	83
	Medium	88	10	98
	Expensive	238	8	246
Total		402	25	427

Note: Of 93 fillies we did not have records on the subject

Table 5: Raced Fillies

		Raced		Total
		No	Yes	
Category Of Sire	Cheap	50	39	89
	Medium	58	60	118
	Expensive	108	205	313
Total		216	304	520

Table 6: Bred Fillies

		Bred		Total
		No	Yes	
Category Of Sire	Cheap	57	32	89
	Medium	58	60	118
	Expensive	75	238	313
Total		190	330	520

Table 7: Age of Fillies at the Start of Breeding

Category Of Sire	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Cheap	7.000	5.639	8.361
Medium	6.000	5.203	6.797
Expensive	5.000	4.758	5.242
Overall	6.000	5.789	6.211

Table 8: Parity of Fillies

Category of Sire	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Cheap	4.000	2.900	5.100
Medium	4.000	3.008	4.992
Expensive	4.000	3.421	4.579
Overall	4.000	3.494	4.506

Table 9: Hacks in All Generations

		Hack		Total
		No	Yes	
Category Of Sire	Cheap	300	9	309
	Medium	395	15	410
	Expensive	704	13	717
Total		1399	37	1436

Table 10: Mares Raced

		Raced		Total
		No	Yes	
Generation	Foals	107	223	330
	Dams	168	350	518
	Granddams	193	318	511
Total		468	891	1359

Table 11: Age at the Start of Breeding Every Generation

Category Of Sire	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Cheap	6.000	5.767	6.233
Medium	6.000	5.754	6.246
Expensive	6.000	5.754	6.246
Overall	6.000	5.892	6.108

Table 12: Age at the Start of Breeding per Generation

Generation	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Foals	6.000	5.789	6.211
Dams	6.000	5.844	6.156
Granddams	6.000	5.815	6.185
Overall	6.000	5.892	6.108

Table 13: Parity of Every Generation

Category of Sire	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Cheap	3.000	2.587	3.413
Medium	4.000	3.499	4.501
Expensive	4.000	3.637	4.363
Overall	4.000	3.779	4.221

Table 14: Parity of Mares per Generation

Generation	Median		
		95% Confidence Interval	
	Estimate	Lower Bound	Upper Bound
Foals	6.000	5.559	6.441
Dams	4.000	3.599	4.401
Granddams	3.000	2.674	3.326
Overall	4.000	3.740	4.260

Table 135 Sire Category of Dams and Granddams

		Category of Sires Dams and Granddams			Total
		Cheap	Medium	Expensive	
Category of Sires 1999 Foals	Cheap	54	60	64	178
	Medium	61	71	104	236
	Expensive	118	190	320	628
Total		233	321	488	1042

Table 16: Sire Category of Dams

		Category of Sires Dams			Total
		Cheap	Medium	Expensive	
Category of Sires 1999 Foals	Cheap	26	31	32	89
	Medium	23	32	63	118
	Expensive	45	98	171	314
Total		94	161	266	521

Table 17: Sire Category of Granddams

		Category of Sires Granddams			Total
		Cheap	Medium	Expensive	
Category of Sires 1999 Foals	Cheap	28	29	32	89
	Medium	38	39	41	118
	Expensive	73	92	149	314
Total		139	160	222	521