EFTBA Veterinary Newsletter 25

Performance Limits, Durability and Soundness

November 2017

- *A limit to the speed of Thoroughbreds appears to have been reached*
- *Statistical analyses tell us that speed has limits, but not what accounts for these limits*
- *Are attempts to breed faster horses producing more fragile animals?*
- *The first essential for performance is soundness*

Welcome to EFTBA's veterinary newsletter

Dear Members,

Again it is a pleasure to introduce our veterinary newsletter which Hans Peter painstakingly undertakes to do on our behalf.
If anyone has any requests for particular information, relevant to our members or their breeders please do not hesitate to submit the question, either directly to him or through me.

I would like to advise you I attended the conference in Brussels on many horse related matters.
I was accompanied by Nick Elsass.
We were invited as we are members of the European Horse Network. This is a body of which I was sceptical before, but now see totally how effective they are.
Their Chairman Mr Mark Wentein is a true net worker and seems to get things done.
Our contribution is well worth it and the membership is going up a 100 euros to 600 for next year.
They are fortunate to have the facilities of Florence Gras who works for EPMA, to assist their work.

There were many things discussed, including the sale of horses, and European Law, in the context of consumer goods, which they are trying to fit the equine into.
MEP Frederic Federley believes this can be resolved to horsemen satisfaction.
Alix Choppin gave us an excellent presentation on how international and liquid (by way of sales) high quality Thoroughbred horses can be.
She discussed the good thigs and the impediments which stand in the way of trade. I will have more on this at our next meeting.

The real meeting was about Brexit. I will also fill you in about that when we meet. The consequences of a bad Brexit were spelt out and it has ramifications for our Industry also, which we will explain at our meeting next week.
I wish those of you traveling a safe trip and I look forward to seeing you.
To those not able to join us we will have the minutes out early.

With kind regards

Joe Hernon

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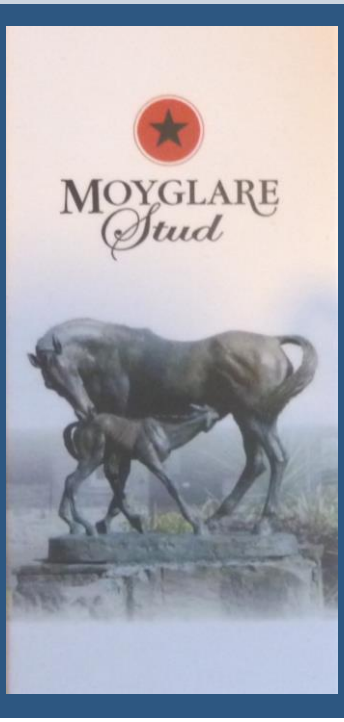
Chairman, EFTBA

"Many thanks to Mrs. Eva-Maria Bucher-Haefner, Moyglare Stud Farm, for her valued sponsorship of this newsletter."



Editorial

In our days, if someone wants to know something about an unfamiliar subject, 'Wikipedia' most likely is the first source for information.

In regard to horseracing, there we find: "*The racecourse test means that the most important selection criteria for breeding the Thoroughbred is the ability displayed on the racetrack. It measures a horse's ability to win, which requires a certain combination of speed and stamina depending on the race in question.*"

For the public, speed and stamina therefore may be primary subjects of interest and in this context we should be prepared to answer possible questions. However, we also know about limits of selection and performance in Thoroughbreds; for that reason, with this issue, we want to devote ourselves to research in the field of performance limits.

Dr Hanspeter Meier

EFTBA veterinary advisor & Newsletter editor

Introduction

In our last newsletter, we discussed different facts, figures and opinions on the subject of running times and genetic research on this issue. There we concluded with the view of Sharman and Wilson (2015) that the question "Are racehorses getting faster?" still can't be answered well enough. However, a reason for this has been addressed by different authors – the "performance limits", or, with other words, "the nature of the horse" [e.g. Gaffney and Cunningham (1988) NL 24; James (1990) NL 22].

Amazingly, on this issue are not many publications available, especially not from experts in horse racing but from authors doing basic research in biology, as for instance Mark W. Denny (CA), almost ten years ago.

Limits to running speeds in dogs, horses and humans

In the Journal of Experimental Biology, Denny (2008) asked the principal questions ***"Are there absolute limits to the speed at which animals can run?"*** and ***"If so, how close are present-day individuals to these limits?"***

He approached these questions by using statistical models only – and therefore just theoretically and pretty complicated. He analysed data from competitive races to estimate maximum running speeds for greyhounds, thoroughbred horses and elite human athletes. In regard to Thoroughbreds however, he obviously wasn't very familiar with the subject of racing. For instance, he investigated the Kentucky Derby and both the Preakness and Belmont Stakes and stated that these were run by 2-year olds. We therefore shouldn't feel too uncomfortable with his complicated equations – to each his own.

His data suggest that there are limits to the ability of either natural or artificial selection to produce ever faster dogs, horses and humans – but here, we only will occupy ourselves with the Thoroughbred.

First of all, Denny (2008) reminds us that legged locomotion is a complicated process. It requires the coordinated application of forces by muscles and skeletal 'springs', and the mechanical and neural coordination of these forces can be complex. In turn, the acceleration of the body's various masses and the contraction of muscles place stresses on an organism's skeleton that can be potentially harmful. The metabolic demands of locomotion vary with the morphology, size, speed and gait of the animal.

In his opinon, we should be able to accurately predict how fast an animal can run if we understand its physiology and mechanics of locomotion.

Several approaches have been applied to this task. Maximum running speeds have been predicted based on:

1) the mass of the body or of its locomotory musculature
2) the rate at which energy can be provided to the limbs
3) the ground force muscles can produce
4) the stiffness of the 'spring' formed by the muscles, ligaments and skeleton
5) the aerobic capacity of the lungs and circulatory system
6) the strength of bones, ligaments and tendons

All of these factors vary with body size, limb morphology and the distance over which speed is measured.

Therefore, the predictive accuracy of speed measurements is often still highly questionable (McNeill Alexander, 2003) – even in humans, though they should be ideal experimental "animals" in many respects. They are expected to be intelligent and highly motivated to accomplish a given task, but even despite the wealth of experimental data from a vast number of speed trials, it has proven difficult to quantify the maximum running speeds of humans.

The same problem applies to other well-studied species. Horses and dogs have raced competitively for centuries, and one might suppose that their maximum speeds would be well established. But, as with humans, the speed of horses and dogs has increased through time.

The upward trend through time in race speeds for dogs, horses and humans demonstrates that advances in training and equipment, and evolution of the species itself (through either natural selection or selective breeding), can increase running performance.

But improvements of the magnitude observed over the last century cannot continue indefinitely: for any given distance, any species will eventually reach its limits.

Greyhounds and thoroughbreds have been the subject of intensive selective breeding. How successful has this breeding been in producing fleet animals?

Materials and methods

For the estimation of maximum running speeds, Denny (2008) used the statistics of extremes – the US Triple Crown races – and three statistical modeling approaches (so-called 'logistic model', 'no-trend model' and 'population-driven analysis').

With these three races, he investigated only a narrow range of distance, from 1911 m (Preakness Stakes) to 2414 m (Belmont Stakes).

For the Kentucky Derby (2012 m) he obtained winning times for the years 1896-2008, for the Preakness Stakes for 1925-2008 and for the Belmont Stakes for 1926-2008.

Results

The temporal patterns of winning speeds for the US Triple Crown are shown in tables 1 and 2 (page 4). There is no significant correlation between year and winning speed in the Kentucky Derby for the period 1949 to 2008. An apparent plateau (green lines) was reached later in the Preakness (1971) and Belmont Stakes (1973) also.

Discussion

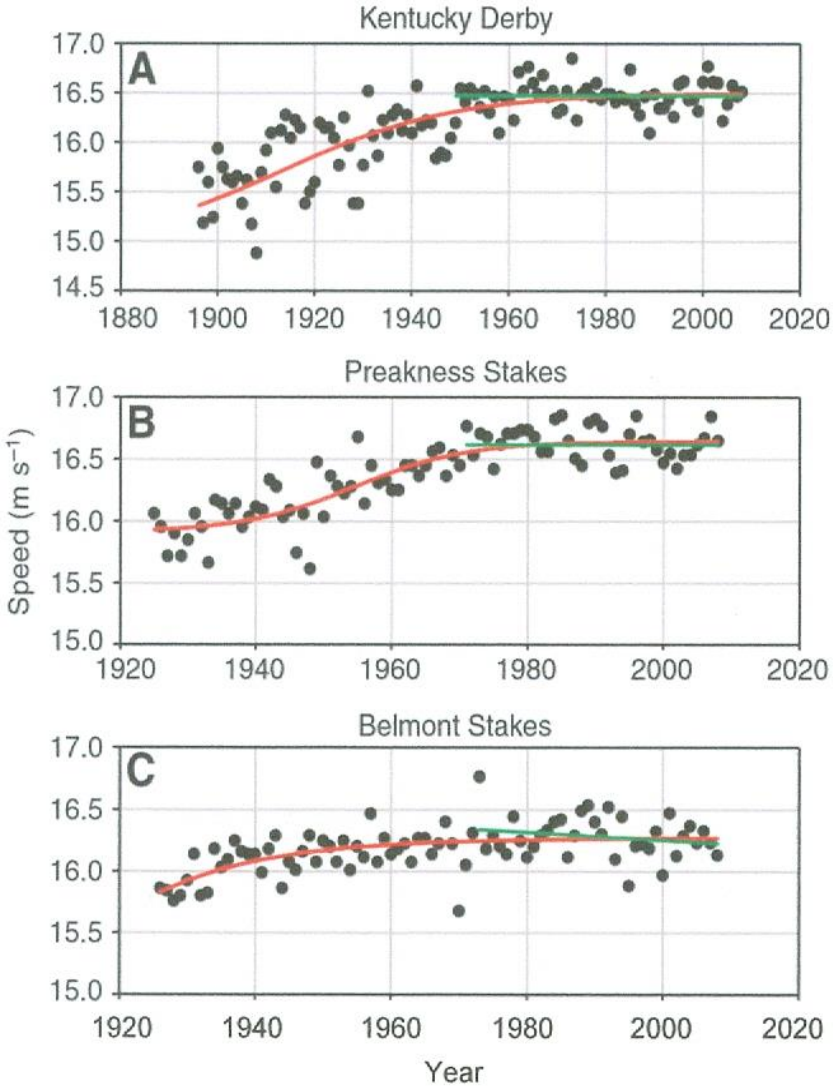
Denny (2008) does admit that these results provide only tentative answers to his introductory questions. **There appear to be definable limits to the speed** at which Thoroughbreds can cover a given distance, and in his opinion, **current record speeds approach the predicted limits**. Present-day horses are indeed near their locomotory limits and he thinks that they (and the limits they approach) can serve as appropriate standards against which to compare predictions from mechanics and physiology.

According to him, the case for defined limits in horses is particularly strong. Despite intensive programs to breed faster Thoroughbreds, despite increasing populations from which to choose exceptional individuals, and despite the use of any undetected performance-enhancing drugs, race speeds have not increased in the last 40 - 60 years. Thus, a limit appears to have been reached, subject only to a slight further increase due to random sampling (Denny, 2008).

Evolution

Is it reasonable to suppose that the evolution of speed in horses has reached its limits? In a restricted sense, Denny's answer is **yes**. The equipment used in horse racing, and the surfaces of the tracks on which these races are contested, did not change appreciably during the years when speeds were increasing in the Triple Crown races, and they have not changed since. Nor were there any apparent breakthroughs in training or nutrition that led to the increases in speed in Thoroughbreds in the first half of the twentieth century. It seems likely, then, that the initial increase in speed in horses was due primarily to selective breeding. If this is true, evidence from the Triple Crown races suggests that the process of selective breeding of Thoroughbreds (as practiced in the US) is incapable of producing a substantially faster horse: despite the efforts of the breeders, speeds are not increasing (Denny, 2008).

Finally, Denny (2008) wonders whether current attempts to breed faster horses may instead be producing horses that are more fragile. In this respect, he referred to a publication of Drape (2008) in the New York Times. This article appeared after the fatal accident of *Eight Belles* in the Kentucky Derby on the 3rd of May. This was believed to be the first fatality in the history of this race, and in this connection the author cited the "Durability List" of US stallions. This list shows how many of a sire's foals actually make it to the racetrack – meant to be an indication of collective soundness – as well as how many starts his offspring averages. In the case of *Eight Belles* and her fate, he also presented these figures of her sire *Unbridled's Song* and of *Boundary*, the sire of the Derby-winner *Big Brown* (Tab. 3, page 5) (Drape, 2008).



Tab. 1 Temporal patterns of winning speeds in the US Triple Crown races. Black dots are winning speeds in the years shown. Green lines are regressions for data in the plateau of each record (any slope of these regression lines is statistically insignificant – s. table 2). Red lines are the "best-fit logistic models" (Denny, 2008).

	Predicted maximum speed (m s⁻¹)				
	Plateau year	Logistic model	No-trend model	Current record	Average increase (%)
Kentucky Derby 2012 m	1949	17.071	16.966	16.842	1.05
Preakness Stakes 1911 m	1971	17.090	16.914	16.853	0.88
Belmont Stakes 2414 m	1973	16.899	17.031	16.877	0.52

Tab. 2 Predicted and current record maximum speeds for thoroughbreds running a distance of 1911–2414 m

During the current plateau in speeds, there is no significant correlation between speed and year

Sire	%age of foals that make it to the racetrack	Average Lifetime Starts
Unbridled's Song *(Eight Belles)*	65%	12.7
Boundary *(Big Brown)*	77%	17.1

Tab. 3 The figures of *Unbridled's Song* and *Boundary* in the "Durability List" of 2008

In 2008, the breed's average of foals that make it to the racetrack was 71%, and the national average for lifetime starts was 16 (Drape, 2008).

The hypothesis of fragility was also dealt with in a comprehensive review of Finley (2010): **"Do We Need a Sturdier Racehorse?"** (Thoroughbred Daily News).

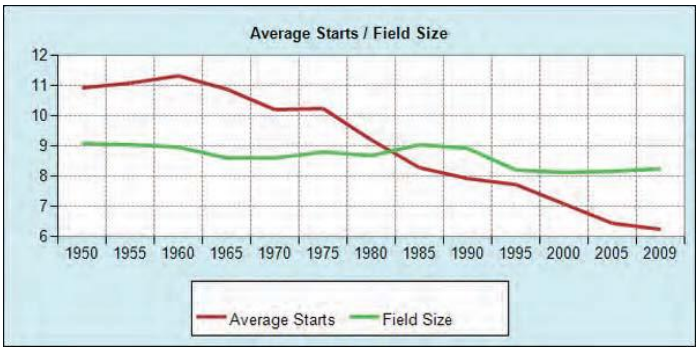
In this publication, Finley (2010) justifies his undertaking with the subtitle „racing grapples with smaller fields and fewer starts"; and indeed, statistics illustrate such a development (tables 4 and 5).

Year	Runners	Starts	Average Starts/Year
1950	22'388	244'343	10.91
1960	29'798	337'060	11.31
1970	47'778	488'326	10.22
1980	64'506	593'849	9.21
1990	89'716	712'494	7.94
2000	69'569	493'682	7.10
2010	68'235	417'192	6.11

Tab. 4 Figures on runners, total starts and average starts per year from 1950 to 2010

Statistics of the US Jockey Club

(Wikipedia; Racehorse Injuries > Breeding)



Tab. 5 Average Starts and Field Sizes in North American Racing 1950-2009 (Finley, 2010)

Grayson-Jockey Club Research Today, Vol. 27 No. 2

In 2010, the average number of starts per horse was down to 6.11, a 46% percent decline over the 1960 numbers (50 years). That's among the reasons why so many believe the modern Thoroughbred is a veritable weakling, unable to stand up to the pressures of racing, prone to injury and no match for his tough-as-steel counterpart from the '40s, '50s and '60s.

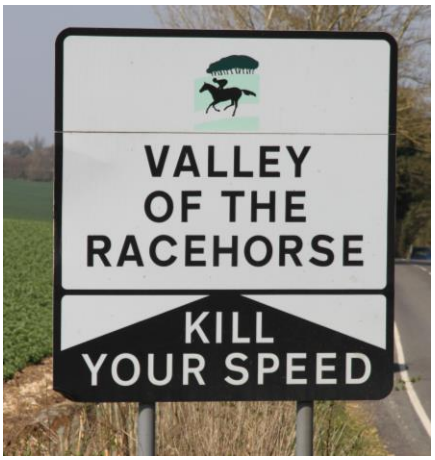
"There's no doubt, we are breeding a weaker horse," said Arthur Hancock, one of these exponents. *"The big problem is all the medication. We are breeding a chemical horse"* – a theory many people share.

Others believe the cause of the apparent weakening of the athlete is due to the changes in the way horses are bred in modern times. Everyone, or so it seems, wants to breed for speed and not stamina, and if that means breeding a horse that raced just five times before breaking down to an unraced mare, so be it.

Or maybe it has something to do with year-round racing, or problems with track surfaces? – Theories abound.

Among those trying to answer the questions are a number of scientists, people whose perspective may be different from that of the typical horseman. Why has the breed changed? They argue that it hasn't. Dr. James MacLeod (University of Kentucky) cannot see any reason why horses now are any weaker or more injury prone than horses from 40 or 50 years ago. He says that not nearly enough time has gone by for the breed to undergo any sort of significant change. *"It is hard to arrive at a genetic explanation for a shift in the population as large and as diverse as Thoroughbreds in such a short period of time. Purely on the genetics and looking at what is this animal and the biomechanics of its tissues, it is difficult to support an inherited biological mechanism to explain why horses race much less frequently today than three to five decades ago."*

The geneticist Doug Antczak (Cornell University) mentioned: *"If we are breeding more for speed, then there will be more horses selected to go into training that were bred to be that type. Then, we have more horses that have the phenotype or the genetic or physiological makeup to break down more easily. You will have more breakdowns and the horse will seem more fragile. That's what I think is happening. We have changed the relative proportion of lighter faster horses from more solid endurance-type horses"* (Finley, 2010).



Traffic sign near Lambourn (UK)

Dr. Ernest Bailey (Gluck Equine Research Center) says *"There's no evidence to support the theory that the modern horse is somehow less sturdy or strong than the horse of the mid-20th century. Forty to fifty years is a very short time to manifest such an extensive change in such a large population of horses, worldwide. Gene frequencies change at a glacial speed for large populations like the Thoroughbred. The onset of the problem appears to be fairly abrupt, and that is more consistent with changes in management"* (Finley, 2010).

In respect to "management", the US Jockey Club Information Systems (TJCIS) came up with some findings regarding two-year-olds and racing. It appears that modern trainers are not pushing their two-year-olds hard enough (an issue we already occupied ourselves with in NL 9, June 2013).

According to the TJCIS research, in 1964, 52% of the foal crop of 1962 raced as two-year-olds. Those two-year-olds averaged 6.9 starts, and two-year-old races accounted for 11.6% of all races run that year. In the period from 2004 to 2009, only 30% of the applicable foal crop raced as two-year-olds and they averaged about 3 starts per horse. Races for two-year-olds accounted for only 7.9% of the total races run (Finley, 2010).

The equine surgeon Larry Bramlage took those numbers one step further and found that a horse that races as a 2-year-old is likely to have a lengthier, healthier career. *"This data is definitive"* Bramlage said during a speech in 2008 before The Jockey Club Round Table. *"It shows that horses that began racing as two year-olds are much more successful, have much longer careers and, by extrapolation, show less predisposition to injury than horses that did not begin racing until their three-year-old year. It is absolute on all the data sets that the training and racing of two-year-old Thoroughbreds has no ill effect on the horses' race-career, longevity or quality. In fact, the data would indicate that the ability to make at least one start as a 2-year-old has a very strong positive affect on the longevity and success of a racehorse"* (Finley, 2010).

Summarizing all these opinions, Finley (2010) thinks that arguably the single biggest difference between racing now and then is that drugs are a much bigger part of the equation. He cites the owner-breeder Gary Biszantz who fondly remembers a simpler time when horses ran without any assistance from a plethora of medications. Biszantz raced his first horse in 1956 and, of course, it ran without bute, Lasix, anabolic steroids, corticosteroids, clenbuterol or anything else. Over the years, Biszantz saw drugs creep more and more into the fabric of the sport. He, like most other owners, was told that drugs would do the horses, the sport and the owners nothing but good; they would create healthier horses that, thanks to the magic of modern medicine, were able to run more often than ever. *"Horses are not the same,"* he said. *"The veterinary community misled the American racing industry into thinking that increasing the amounts of medication we gave these horses would do numerous good things. It would make them run faster, their careers would be longer, the field sizes would be larger and they would get hurt less often. One hundred percent of everything what they said has gone the other way. We have seen a dramatic increase in the amount of medications given to horses and careers have never been shorter. We have smaller fields than ever and the horses don't have as much stamina"* (Finley, 2010).

Arthur Hancock also believes that the influx of drugs and medications, legal and otherwise, is at the crux of the problem. He says that the reason horses don't last is that, instead of being given time to heal when they are hurt, they are injected with drugs in order to get them back on track (Finley, 2010).

(In 2010, Bill Finley won the Media Eclipse Award for Writing in the News/Enterprise category for "Do We Need a Sturdier Racehorse").

Conclusions

Concluding his presentation, Denny (2008) admits that his analysis deals solely with the results of competitive races, not with the factors that cause a certain individual to win or lose: *"In this respect, my*

results are as unsatisfying as those of previous statistical analyses: they tell us that speed has limits, but not what accounts for these limits."

Nonetheless, the pattern of estimated maximal speeds provides information of potential value to physiologists and biomechanicians. It seems unlikely that a single mechanical or physiological factor could account for the limit to speed at all distances. The height and mass of elite runners differs among race distances as does the ability of aerobic capacity to predict speeds (Denny, 2008).

What does that mean for us? - There obviously are many more important issues, e.g. physiology and biomechanics, to discuss in further newsletters.

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