National Equine Forum

Breeders – what should we do?

Andy Dell

Just in Time – Using Science to Save Our Breeds

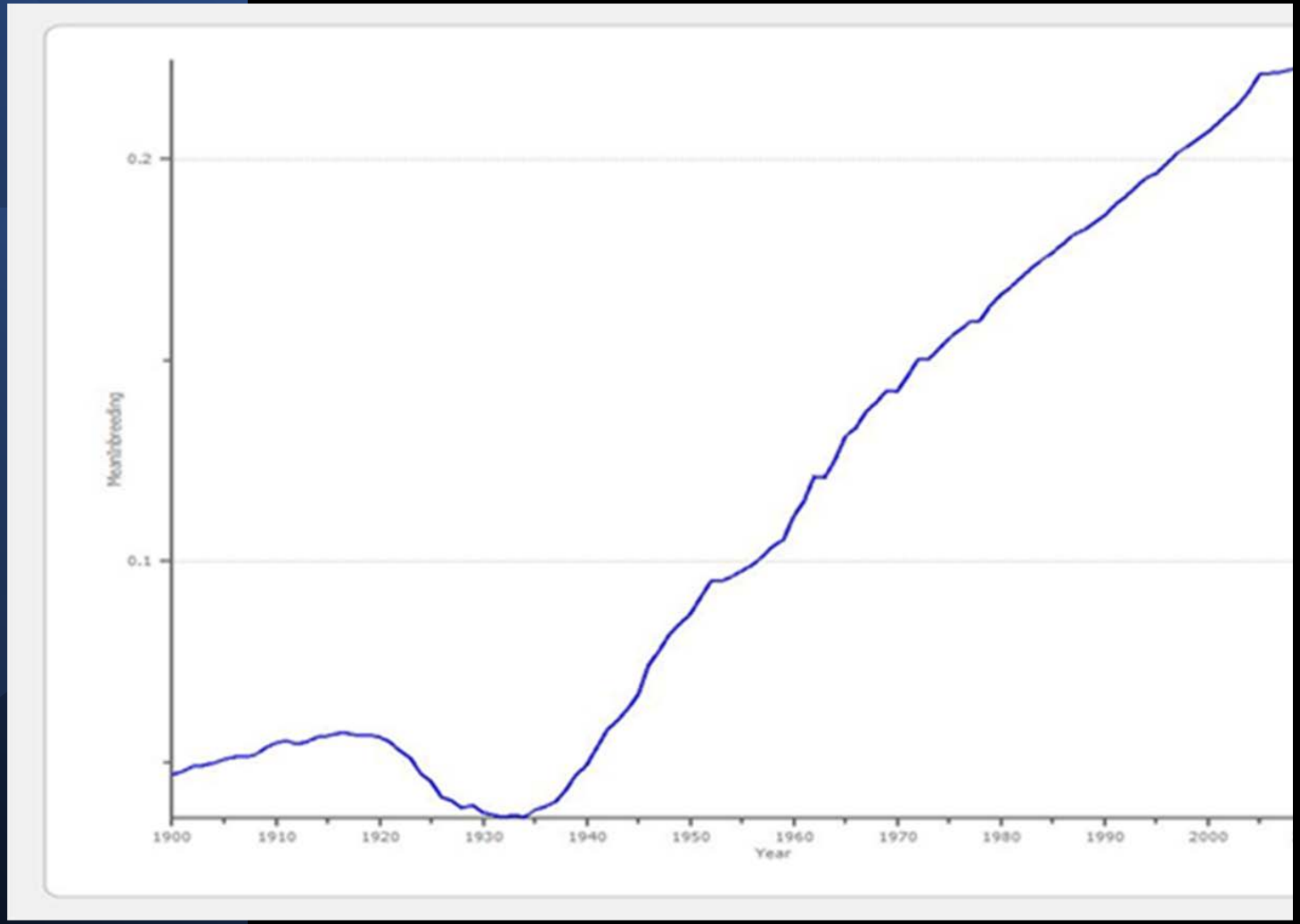
Wednesday 13th January 2021

Using Science To Save Our Breeds
Breeders – What Should We Do?

SPARKS

Single Population Animal Records Keeping Software

Mean Inbreeding in the Cleveland Bay Horse 1900 to 2000



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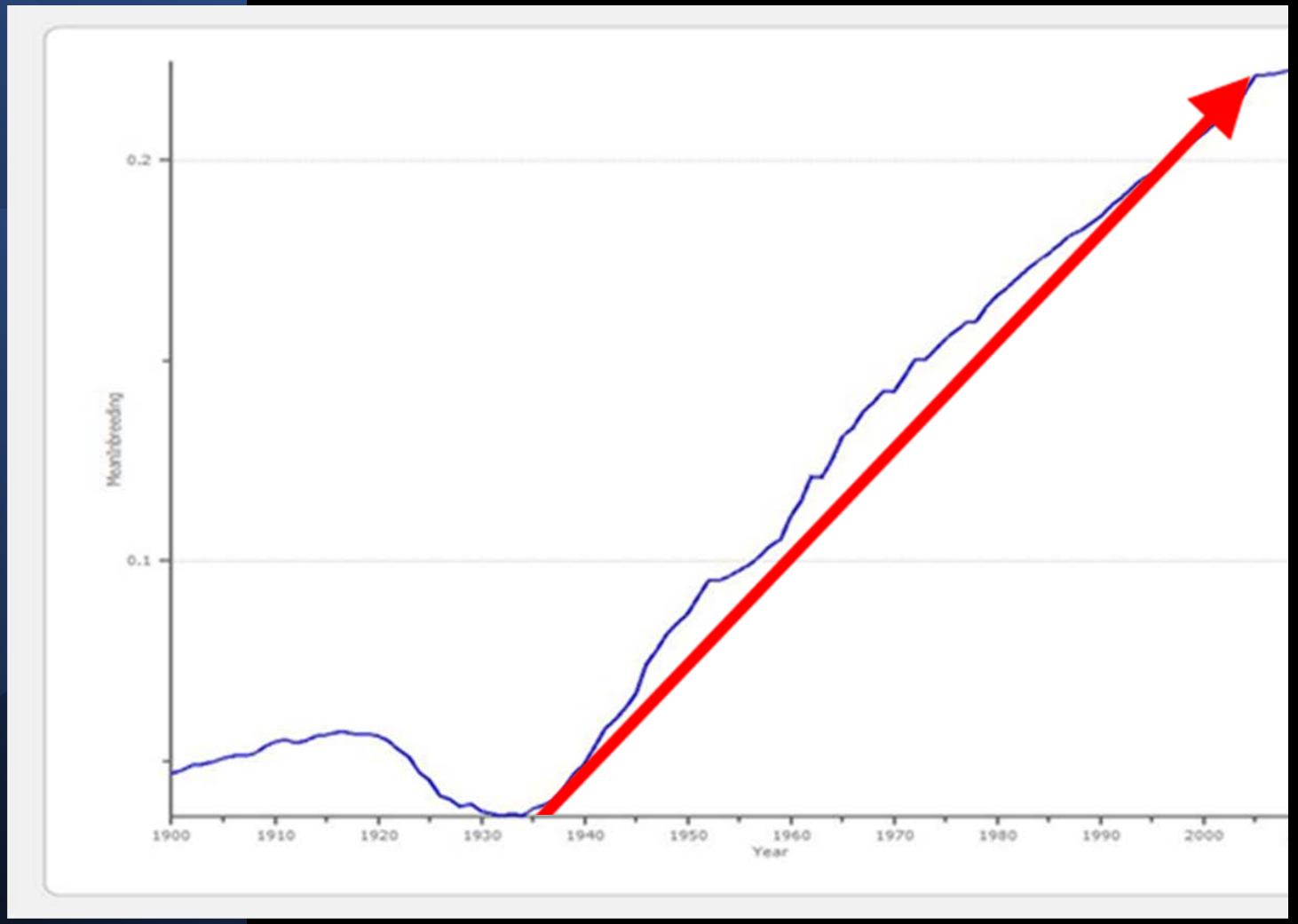

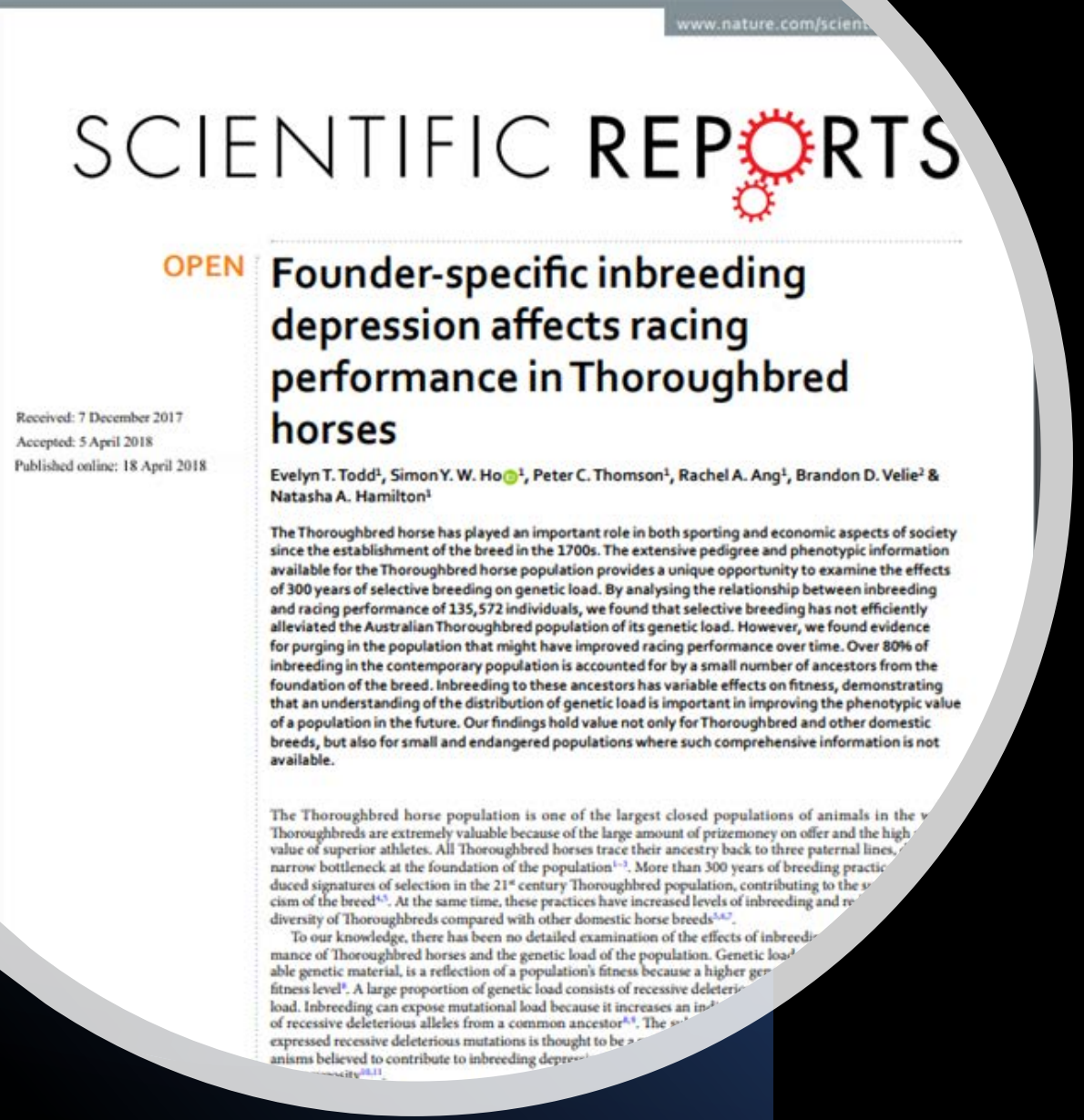

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SCIENTIFIC REPORTS

OPEN

Founder-specific inbreeding depression affects racing performance in Thoroughbred horses

Received: 7 December 2017
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Evelyn T. Todd[1], Simon Y. W. Ho[1], Peter C. Thomson[1], Rachel A. Ang[1], Brandon D. Velie[2] & Natasha A. Hamilton[1]

The Thoroughbred horse has played an important role in both sporting and economic aspects of society since the establishment of the breed in the 1700s. The extensive pedigree and phenotypic information available for the Thoroughbred horse population provides a unique opportunity to examine the effects of 300 years of selective breeding on genetic load. By analysing the relationship between inbreeding and racing performance of 135,572 individuals, we found that selective breeding has not efficiently alleviated the Australian Thoroughbred population of its genetic load. However, we found evidence for purging in the population that might have improved racing performance over time. Over 80% of inbreeding in the contemporary population is accounted for by a small number of ancestors from the foundation of the breed. Inbreeding to these ancestors has variable effects on fitness, demonstrating that an understanding of the distribution of genetic load is important in improving the phenotypic value of a population in the future. Our findings hold value not only for Thoroughbred and other domestic breeds, but also for small and endangered populations where such comprehensive information is not available.

The Thoroughbred horse population is one of the largest closed populations of animals in the w
Thoroughbreds are extremely valuable because of the large amount of prizemoney on offer and the high
value of superior athletes. All Thoroughbred horses trace their ancestry back to three paternal lines,
narrow bottleneck at the foundation of the population[1–3]. More than 300 years of breeding practic
duced signatures of selection in the 21st century Thoroughbred population, contributing to the s
cism of the breed[4,5]. At the same time, these practices have increased levels of inbreeding and re
diversity of Thoroughbreds compared with other domestic horse breeds[5,6,7].

To our knowledge, there has been no detailed examination of the effects of inbreedi
mance of Thoroughbred horses and the genetic load of the population. Genetic loa
able genetic material, is a reflection of a population's fitness because a higher ge
fitness level[8]. A large proportion of genetic load consists of recessive deleteri
load. Inbreeding can expose mutational load because it increases an in
of recessive deleterious alleles from a common ancestor[8,9]. The s
expressed recessive deleterious mutations is thought to be a
anisms believed to contribute to inbreeding depres
city[10,11].

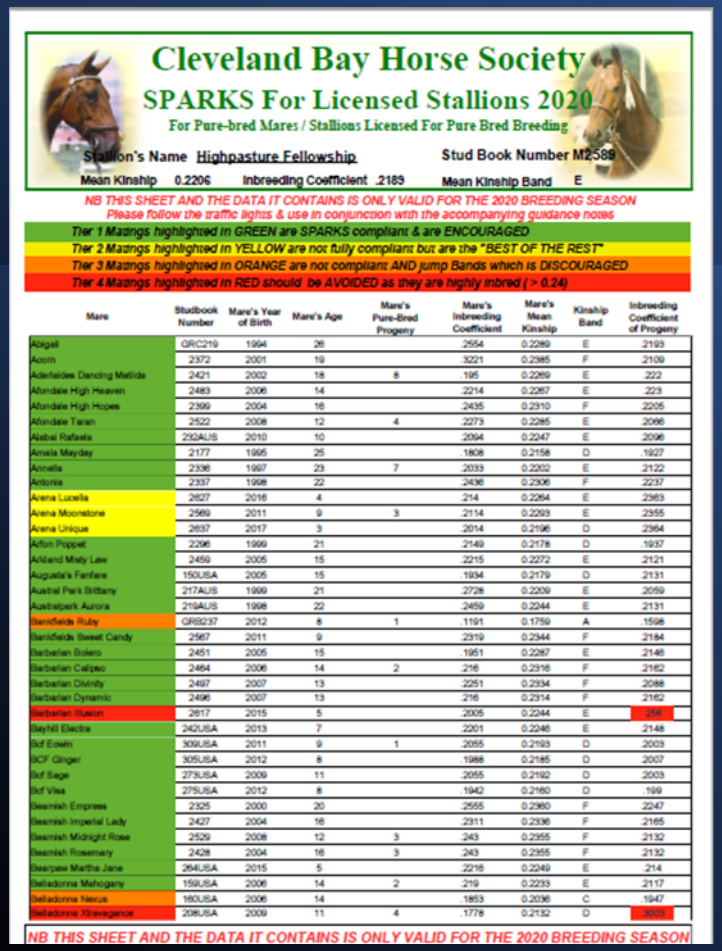
Does Pedigree have a role in a world of Genomics?

- Where pedigree is deep(>10 generations) and robust good correlation between Pedigree based and Genomic inbreeding

Choices For Managing Pedigreed Populations

- Divide the population into sub populations and keep them apart
- Random Mating
- Management of Inbreeding by controlling Mean Kinship

Breeder's Datasheets



Cleveland Bay Horse Society

SPARKS For Licensed Stallions 2020

For Pure-bred Mares / Stallions Licensed For Pure Bred Breeding

Stallion's Name Highpasture Fellowship Stud Book Number M2589

Mean Kinship 0.2206 Inbreeding Coefficient .2189 Mean Kinship Band E

NB THIS SHEET AND THE DATA IT CONTAINS IS ONLY VALID FOR THE 2020 BREEDING SEASON
Please follow the traffic lights & use in conjunction with the accompanying guidance notes

Tier 1 Matings highlighted in GREEN are SPARKS compliant & are ENCOURAGED
Tier 2 Matings highlighted in YELLOW are not fully compliant but are the "BEST OF THE REST"
Tier 3 Matings highlighted in ORANGE are not compliant AND jump Bands which is DISCOURAGED
Tier 4 Matings highlighted in RED should be AVOIDED as they are highly inbred (> 0.24)

Mare	Studbook Number	Mare's Year of Birth	Mare's Age	Mare's Pure-Bred Progeny	Mare's Inbreeding Coefficient	Mare's Mean Kinship	Kinship Band	Inbreeding Coefficient of Progeny
Abigail	GRC219	1994	26		.2554	0.2289	E	.2193
Acorn	.2372	2001	19		.3221	0.2385	F	.2109
Aderfeides Dancing Matilda	.2421	2002	18	8	.195	0.2269	E	.222
Afondale High Heaven	.2483	2006	14		.2214	0.2267	E	.223
Afondale High Hopes	.2399	2004	16		.2435	0.2310	F	.2205
Afondale Taran	.2522	2008	12	4	.2273	0.2285	E	.2066
Aisbal Rafaela	232AUS	2010	10		.2094	0.2247	E	.2096
Amala Mayday	.2177	1995	25		.1808	0.2158	D	.1927
Annella	.2336	1997	23	7	.2033	0.2202	E	.2122
Antonia	.2337	1998	22		.2436	0.2306	F	.2237
Arena Lucella	.2627	2016	4		.214	0.2264	E	.2363
Arena Moonstone	.2569	2011	9	3	.2114	0.2293	E	.2355
Arena Unique	.2637	2017	3		.2014	0.2196	D	.2364
Arfon Poppet	.2296	1999	21		.2149	0.2178	D	.1937
Arkland Misty Law	.2459	2005	15		.2215	0.2272	E	.2121
Augusta's Fanfare	150USA	2005	15		.1934	0.2179	D	.2131
Austral Park Brittany	217AUS	1999	21		.2728	0.2209	E	.2059
Australpark Aurora	219AUS	1998	22		.2459	0.2244	E	.2131
Bankfields Ruby	GRB237	2012	8	1	.1191	0.1759	A	.1598
Bankfields Sweet Candy	.2567	2011	9		.2319	0.2344	F	.2184
Barbarian Bolero	.2451	2005	15		.1951	0.2287	E	.2146
Barbarian Calipso	.2464	2006	14	2	.216	0.2316	F	.2162
Barbarian Divinity	.2497	2007	13		.2251	0.2334	F	.2088
Barbarian Dynamic	.2496	2007	13		.216	0.2314	F	.2162
Barbarian Illusion	.2617	2015	5		.2005	0.2244	E	.256
Bayhill Electra	242USA	2013	7		.2201	0.2246	E	.2148
Bcf Eowin	309USA	2011	9	1	.2055	0.2193	D	.2003
BCF Ginger	305USA	2012	8		.1988	0.2185	D	.2007
Bcf Sage	273USA	2009	11		.2055	0.2192	D	.2003
Bcf Vixi	275USA	2012	8		.1942	0.2160	D	.199
Beamish Empress	.2325	2000	20		.2555	0.2360	F	.2247
Beamish Imperial Lady	.2427	2004	16		.2311	0.2336	F	.2165
Beamish Midnight Rose	.2529	2008	12	3	.243	0.2355	F	.2132
Beamish Rosemary	.2428	2004	16	3	.243	0.2355	F	.2132
Beerpew Martha Jane	264USA	2015	5		.2216	0.2249	E	.214
Belladonna Mahogany	159USA	2006	14	2	.219	0.2233	E	.2117
Belladonna Nexus	160USA	2006	14		.1853	0.2036	C	.1947
Belladonna Xtravagance	208USA	2009	11	4	.1778	0.2132	D	.3003

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Cleveland Bay Horse Society

SPARKS Kinship Table 2020

For Pure-bred Mares / Stallions Licensed For Pure Bred Breeding

Mare's Name Penrose Bayberry Stud Book Number 2363

Mean Kinship 0.2351 Inbreeding Coefficient .2265 Mean Kinship Band F

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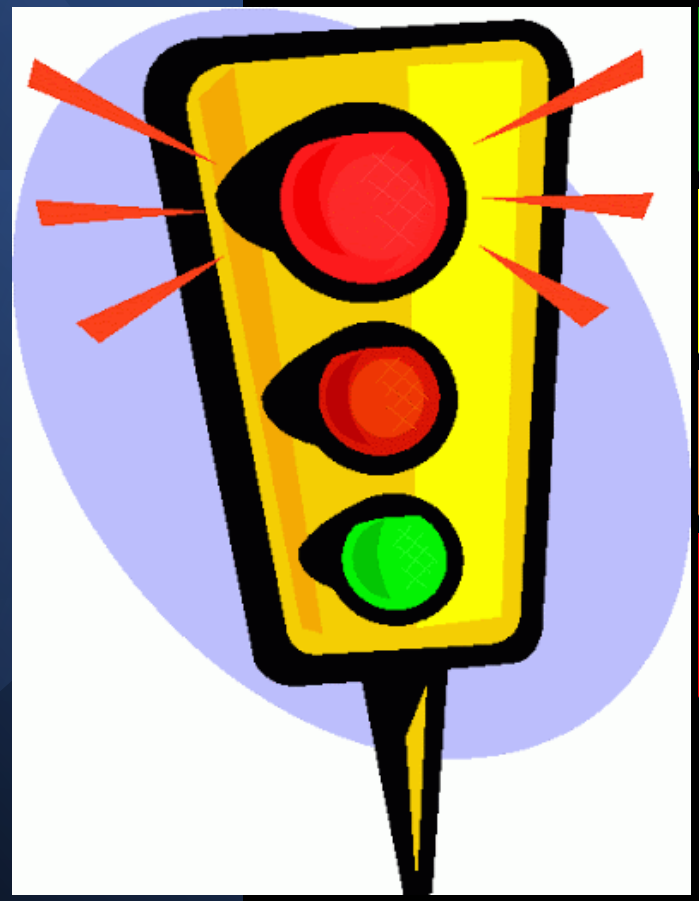
Stallion	Studbook Number	Stallion's Inbreeding Coefficient	Stallion's Mean Kinship	Kinship Band	Inbreeding Coefficient of Progeny	Availability	Stallion's Location
Cholderton Cacus	M2495	.156	0.1990	B	.1918	CONTACT OWNER	ENGLAND
Cholderton bion	M2661	.1714	0.2060	C	.2006	Live Cover, Chilled & Frozen	UK
Cholderton Boreas	M2485	.2389	0.2092	C	.2044	CONTACT OWNER	ENGLAND
Cholderton Jupiter	M2727	.1832	0.2097	C	.2101	Live Cover Only	UK
Wyevale Brayden	M2665	.1988	0.2149	D	.2005	Live Cover & Frozen UK	ENGLAND
Penrhyn Romulus	M2615	.2298	0.2138	D	.2009	Contact Owner	WALES
Cholderton Icarus	M2662	.175	0.2156	D	.2037	Live Cover Only	UK
Folds Victor	M2767	.1908	0.2174	D	.2234	Gelded (Frozen Only)	UK
Fenton	M2531	.2033	0.2197	D	.2239	Live Cover Only	WALES
Penrhyn Sextus	M2584	.2431	0.2224	E	.2078	Contact Owner	WALES
Brackenbrae Somerled	M2842	.222	0.2243	E	.2136	Live Cover Only	UK
Brackenbrae Stormcloud	M2853	.222	0.2240	E	.2136	Live Cover & Chilled	UK
Kirkmoor Wolfsbane Flower	M2762	.2088	0.2255	E	.2196	Live Cover Only	ENGLAND
Highpasture Fellowship	M2589	.2189	0.2206	E	.2205	Live Cover & Frozen UK	WALES
Wyevale Wot A Charmer	M2596	.2199	0.2286	E	.2215	Live Cover & Chilled	UK
Folds Director	M2846	.1946	0.2228	E	.2216	Live Cover,Chilled & Frozen	ENGLAND
Cerolina Charlie Boy	M2718	.2591	0.2287	E	.2224	Live Cover Only	UK
Thomsonbrook Beowulf	M2840	.2136	0.2284	E	.2225	Live Cover & Chilled	UK
Pembridge Justice	M2787	.2353	0.2250	E	.2247	Live Cover Only	ENGLAND
Rosemeadow Springtime	M2770	.2288	0.2264	E	.2274	Live Cover Only	ENGLAND
Bolton Grove Brandon	M2668	.2172	0.2294	E	.2321	Live Cover Only	ENGLAND
Jemoon Highwayman	M2824	.232	0.2293	E	.2325	Contact Owner	UK
Earlswood Traveller	M2649	.2193	0.2293	E	.2341	Live Cover Only	ENGLAND
Willow Troy	M2577	.2058	0.2280	E	.2398	Live Cover Only	ENGLAND
Penrhyn P.S	M2764	.2122	0.2307	F	.2183	Live Cover UK /Frozen AUS	ENGLAND
Beamish Fugleman	M2540	.1996	0.2308	F	.2249	Live Cover Only	ENGLAND
Stainmore Scotch On The Rocks	M2830	.1996	0.2302	F	.2249	Live Cover & Frozen UK	ENGLAND
Cholderton Yobi	M2423	.237	0.2316	F	.226	UK EU USA AUS NZ	WALES
Thomsonbrook King William	M2737	.2102	0.2321	F	.2306	Live Cover Only	UK
Blackclough Kilkenny	M2582	.2208	0.2315	F	.2307	Live Cover Only	UK
Stainmore Lochinvar	M2799	.226	0.2326	F	.2308	Live Cover Only	ENGLAND
Barbarian Gigalo	M2795	.2266	0.2311	F	.2321	Contact Owner	ENGLAND
Billy's Joint Account	M2822	.2314	0.2350	F	.2329	Contact Owner	UK
Crosswaysfarm Albion Bomber	M2882	.2215	0.2306	F	.2339	FROZEN ONLY	ENGLAND
Mulgrave Royal Emperor	M2673	.3057	0.2326	F	.2345	Contact Owner	UK
Braithwaite Challenger	M2648	.221	0.2325	F	.2351	Live Cover & Chilled	UK
Lindon Principal	M2558	.2283	0.2347	F	.2361	CONTACT OWNER	ENGLAND
Halthouse Gladimere	M2836	.2253	0.2311	F	.2371	Live Cover & Chilled	UK
Tynedale St Osmund	M2662	.225	0.2340	F	.2375	Contact Owner	ENGLAND
Kirkmoor Elderberry Flower	M2836	.211	0.2361	F	.238	Live Cover & Frozen UK	UK
Barbarian Hustler	M2834	.2251	0.2335	F	.2383	Contact Owner	UK
Beamish TouchNGo	M2549	.2599	0.2376	F	.2417	Live Cover Only	ENGLAND

- Mare Based & Stallion Based
- For named breeding season only
- Mean Kinship of Mare and Stallions
- Co-ancestry of Progeny

Follow The Traffic Lights



Matings to be Encouraged

Best of the Rest Matings

Matings to be Discouraged

Matings to be Avoided

The Breeder's Toolbox

- Phenotype
- Genotype

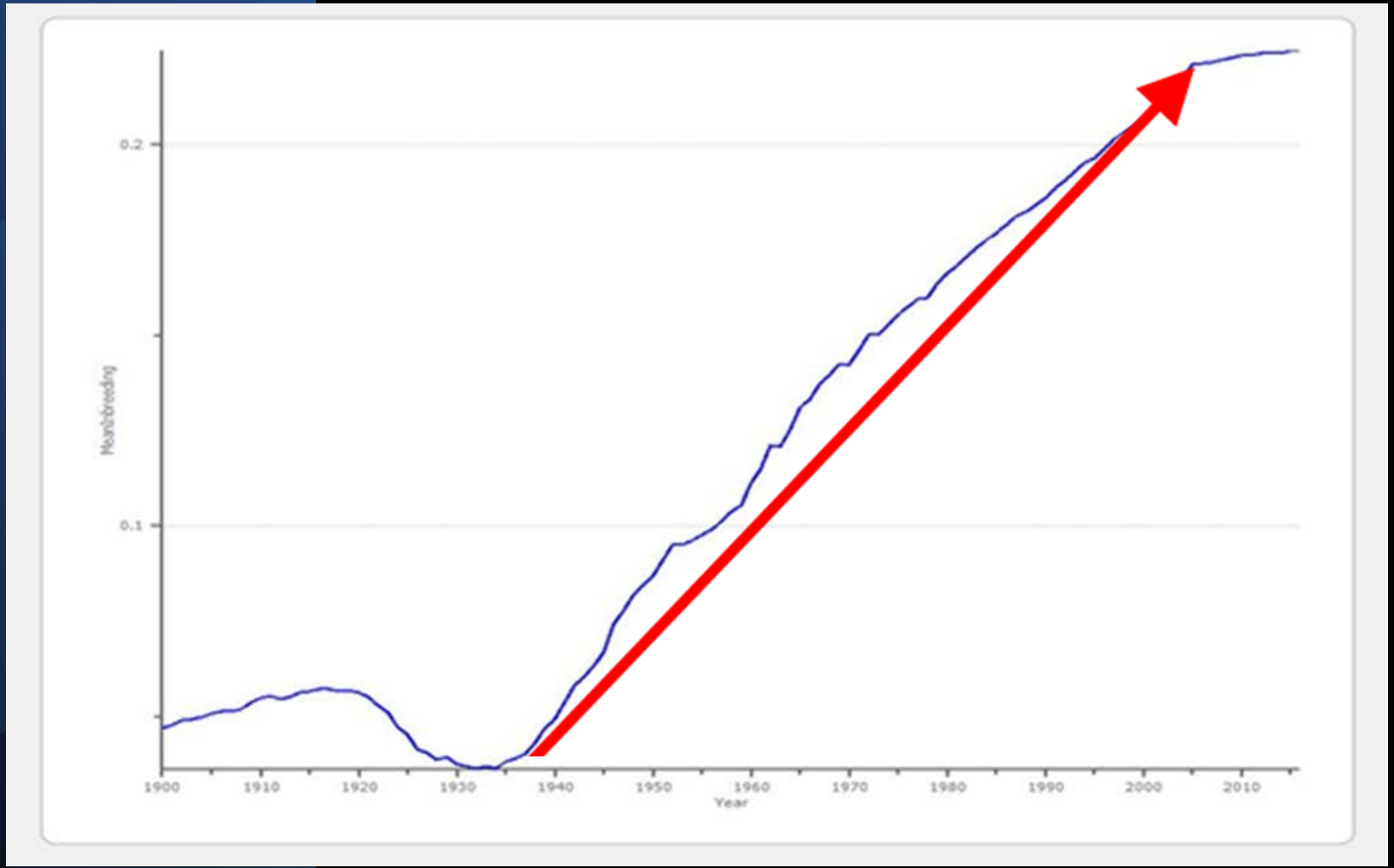
The Breeder's Toolbox

- SPARKS is Another tool in the Breeder's toolbox
- Leaves the breeder in control
- Avoids highly damaging matings
- Maximizes retention of diversity

Factors To Consider When Selecting Matings

- **Prioritise breeding from low Mean Kinship animals**
- **Breed from as many Males and Females as possible**
- **Avoid overuse of a selected small group of Stallions**

Mean Inbreeding in the Cleveland Bay Horse 1900 to 2020



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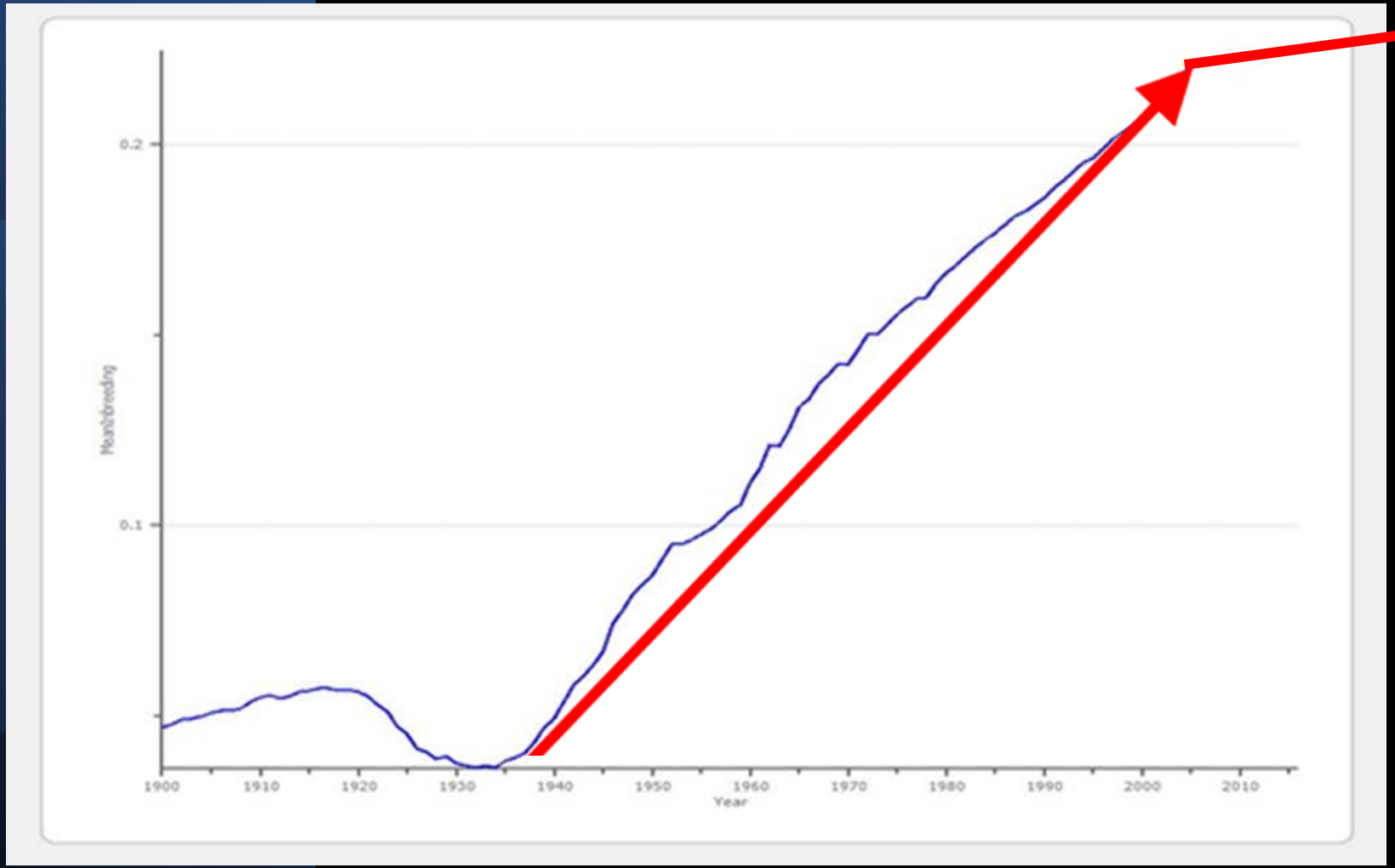
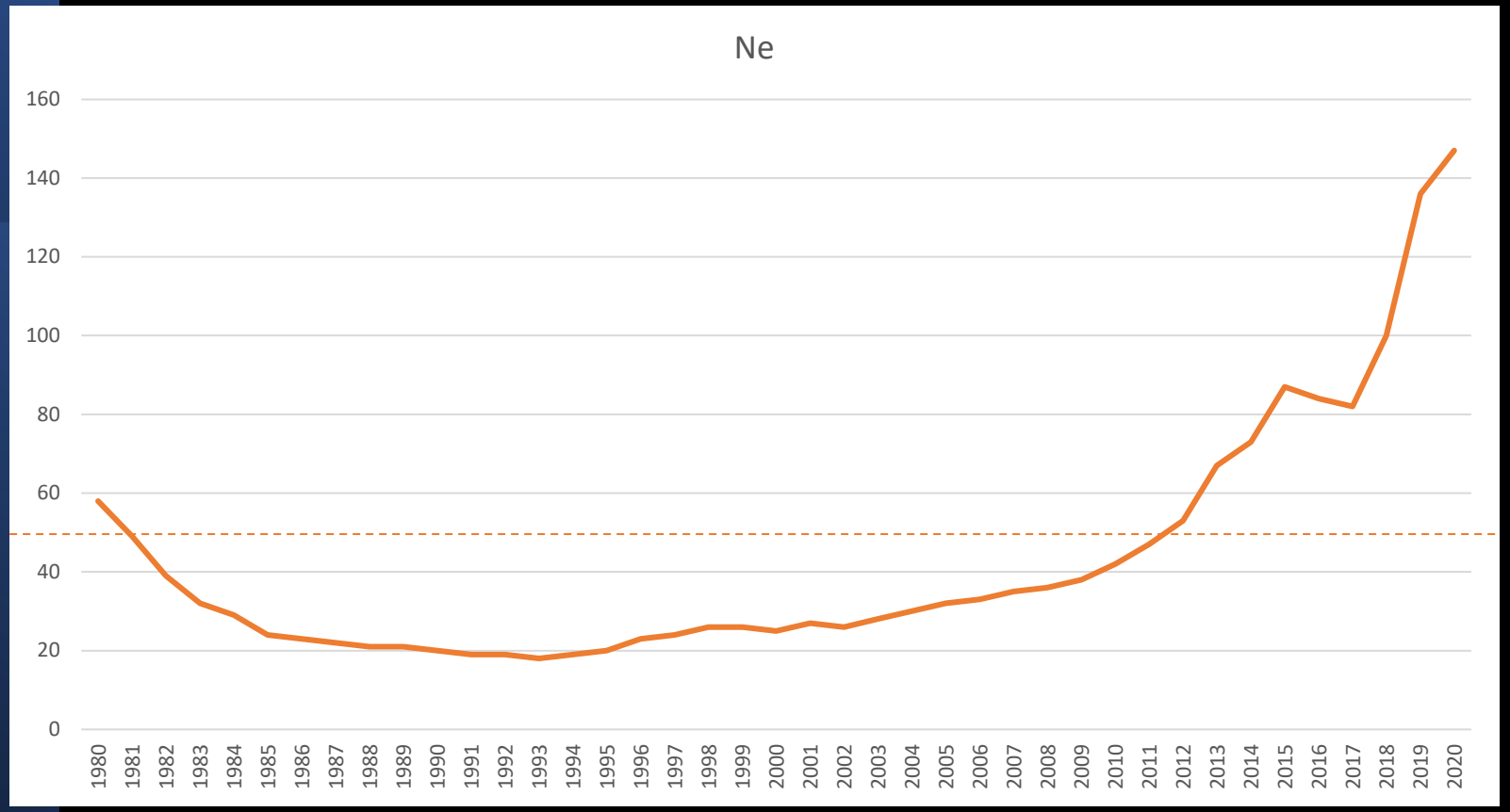


Cleveland Bay Horse Effective Population Size 1980 to 2020



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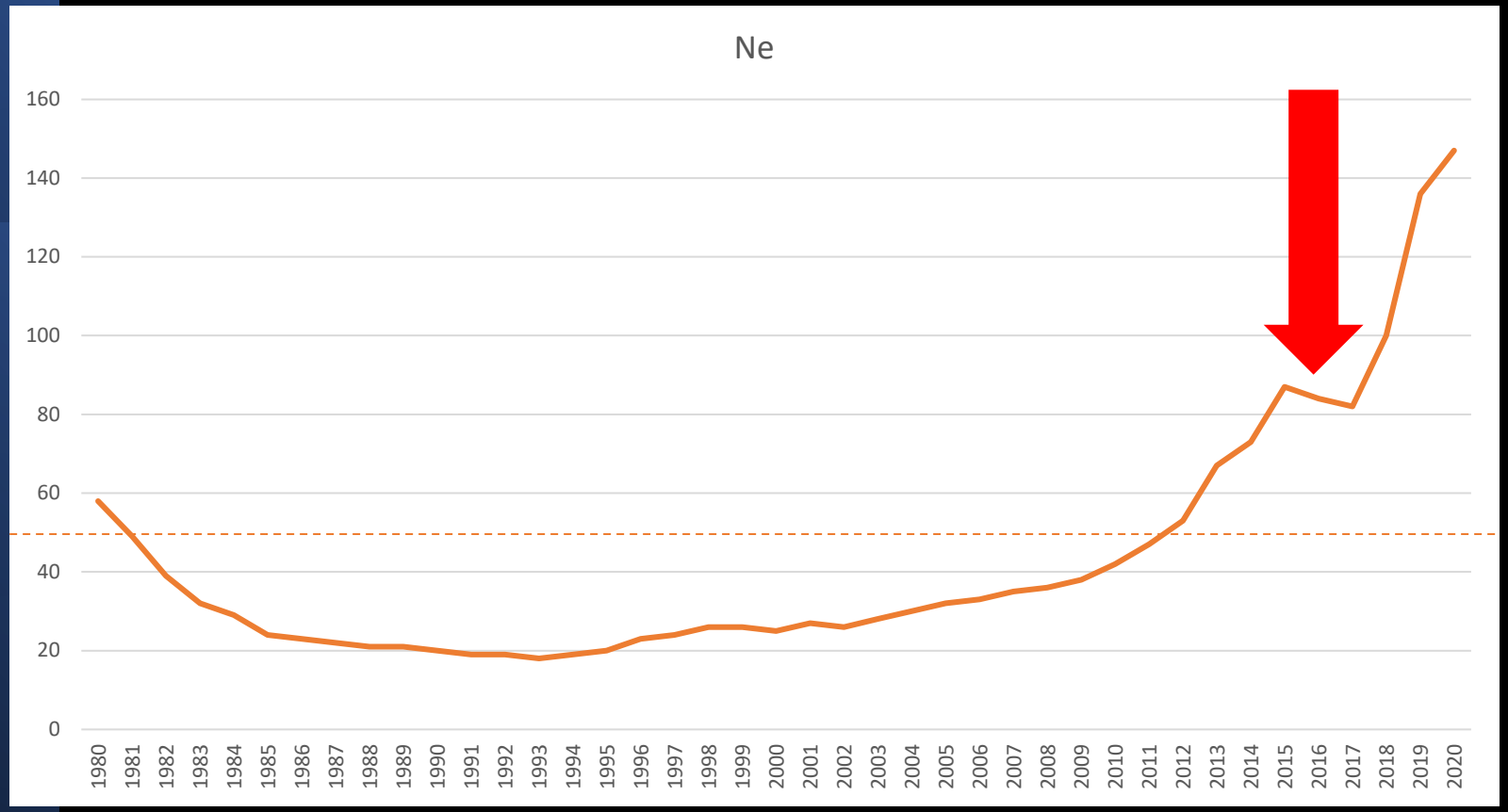

Breeding for The Future Of Our Equine Breeds

- Uncoordinated breeding often leads to a substantial accumulation of inbreeding
- Increased risk of deleterious traits being expressed
- Reflected in diminishing Effective Population Size

Science Can Help !!

National Equine Forum