DETECTING ICELANDIC HORSE ORIGINS

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When visiting web sites about the Icelandic horse, one frequently finds introductions like this:

Vikings from Norway and the British Isles first settled in Iceland in the late 800s AD. They brought their horses and livestock with them on their ships. Since space was limited, only the finest stock was brought to Iceland. After the initial settlement of Iceland, there has been no known import of horses for almost 1000 years. These wonderful, charming, sensible horses are ideal riding horses for people of all ages.

These bare statements beg some larger questions. Where did the Vikings obtain this fine stock? How were the horses kept in Iceland? What cultural and climatic conditions influenced the development of the horse in Iceland? Why are these horses so sensible and charming? Archeology, paleontology, history, art, and literature all combine to give fascinating insights into the bigger picture of the origin of the Icelandic horse. Recent advances in the analysis of mitochondrial DNA (mtDNA) have further enabled scientists to explore the origins of people and animals—including the Icelandic horse.

Today Icelandic horses no longer have to fend for themselves over the winter. But their adaptations to the Icelandic climate certainly enable them to enjoy a crisp winter day in Thingeyrar, Iceland. Photo by Helga Thoroddsen.

These Przewalski's Horses were photographed in a reserve in Czechoslovakia. No extant domesticated horse breed directly descends from this endangered wild horse subspecies, although they share a similar genetic heritage to the Fjord and Icelandic horse. Photo by Eric Andresen.

This article investigates some of these recent findings. Caution: Due to the inherent complexity of the subject, I can only provide superficial answers based on the information I was able to access; there is still considerable debate among scientists about some of these topics.

EQUID EVOLUTION

DNA is the hereditary material passed down from generation to generation. Most DNA is located in the nucleus of the cell. In the nuclear DNA of the horse, 32 chromosomes come from the sire and 32 from the dam. However, mtDNA is located in the mitochondria, which are the part of the cell that converts energy from food directly into a form the cell can use. MtDNA is highly mutatable and evolves frequently over time. In almost all organisms, mtDNA is inherited from the mother only, so that researchers can study changes in a species over time and the evolutionary relationships between different species.

Both the study of skeletal remains

and mtDNA research agree that the branching of the modern equid evolutionary tree occurred in the following order: mountain zebras, followed by asses, followed by the remaining subspecies of zebras, followed by onagers or wild asses, followed by horses (Jansen, Forster, et al., 2002). The current thought is that the horse was descended from the now extinct Tarpan or European wild horse (McCue et al., 2012).

Certain breed descriptions have claimed the Przewalski's Horse, an endangered wild horse, as a direct ancestor. However mtDNA research published in 2011 by Ryder, Fisher, et al. indicates that the Przewalski's Horse diverged from the ancestor of the modern horse approximately 160,000 years ago—long before domestication and the development of modern horse breeds. Interestingly, mtDNA research by McCue, Bannasch, et al. in 2012 shows that the Przewalski's Horse is more closely related to Mongolian, Norwegian Fjord, Belgian, and Icelandic breeds than to other breeds such as Thoroughbreds.

Although the Przewalski's Horse and the domesticated horse differ in their number of chromosomes, the two species can interbreed. McCue, Bannasch, et al. (2012) propose that there was interbreeding of domesticated horses with Przewalski's Horses in the wild where the range of the two equine subspecies overlapped, especially in Mongolia. All existing Przewalski's Horses are the offspring of nine of these horses captured in 1945. Thus, the founding horses were not purebred but hybrids with domesticated horses. The above example serves to caution the reader about making quick assumptions about breed origination on the basis of mtDNA research.

Carol Burckhardt (left), who normally rides an Icelandic horse, about to start a riding trek on a Mongolian horse in Mongolia. The early Norse may have brought Mongolian stock back to Norway, hence the close relations shown by mtDNA studies with certain Norwegian breeds who were brought into Iceland by the early settlers. Photo by Linda Eddy.

HORSE DOMESTICATION

A recent mtDNA study by Jansen, Forster, et al. (2002), suggests that horses were domesticated from several wild populations over time. Most likely the earliest domestication of the horse occurred between 9400 BC and 2000 BC. As these researchers explain, "The ease of domestic horse breeding today may be the genetic consequence of selections of particularly amenable beasts some thousands of years ago…. Burial, textual, and/or iconographic evidence shows that by 1250 BC, chariots were widespread from Greece to China. Such an expansion may suggest a diffusion of the knowledge of horse breeding, and possibly a concomitant spread of horses themselves, originally localized both temporally and spacially. In this reading of the archaeological record, the knowledge and the initially domesticated horses themselves would have spread, with local mares incorporated *en route*, forming our regional mtDNA clusters, which individually had a lower genetic diversity."

Whether horses were domesticated once, with the knowledge spreading outward, or whether horses were domesticated in several different geographic areas at different times is still hotly debated. Achilli, Olivieri, et al. (2012) write that "the Ancestral Mare Mitogenome (AMM) from which all modern horse mtDNAs derive, was dated at ~153 ± 30 thousand years ago." Their study suggests that there were at least 17, possibly many more, founding mares for horse domestication.

Interestingly, Lindgren, Backström, et al. (2004), in their study of genetic markers associated with the male Y chromosome, showed that very few stallions contributed to the genetic composition of the modern horse. "All stallions carried the same Y-chromosome haplotype. This contrasts sharply with the extensive mtDNA diversity and indicates very low levels of Y-chromosome variability in domestic horses." Their data suggests that the use of one stallion to breed multiple mares is a practice that dates to the earliest days of horse domestication.

So one can conclude that at the time of the Norse settlement of Iceland in the later part of the 800s AD, numerous domesticated breeds of horses were pocketed around Europe and Asia, with individual horses traded or stolen between these locations. To fully understand the Icelandic breed, one needs to know a little bit about the Viking explorations and expansions at this time.

NORSE EXPANSION

English sources typically date the beginning of the Viking Age by the burning of the monastery at Lindisfarne in England in 793 AD, and the end at the Battle of Hastings in 1066 AD. Possibly due to population expansion with limited agricultural resources, or just to exploit a power gap after the collapse of Charlemagne's empire in the 830s, groups from Scandi-

Shetland ponies grazing at home in Grutness, Shetland Island. Early Icelandic settlers from the northern islands of England and Scotland would have brought similar stock, capable of surviving harsh weather conditions, with them. Photo by James Tait, Island Trails, Shetland, UK

navia began to expand across Europe.

Viking ships were capable of sailing across large expanses of open ocean and of navigating rivers. Establishing trade routes and both permanent and temporary settlements, the Vikings established outposts in pockets of coastline and rivers along current-day France, Spain, North Africa, and western Italy. Settlers headed to England, Scotland, Ireland, Iceland, the Shetlands, and the Faroe Islands. Other groups navigated the major riverways of Eastern Europe and Russia, eventually reaching the Black and Caspian Seas. Eirik the Red and similar adventurers sailed to North America and established settlements in L'Anse aux Meadows, Newfoundland, and Labrador.

Brown (2001) discusses some of the choices that the Vikings had to make about the horse stock included on their journeys. "Although the settlers used the deep-keeled knarr—not the dragon ship, the slim longship people usually associate with Vikings—their horses had to compete for space with cattle, sheep, timber, grain, weapons, jewelry, tools, clothing, rugs, tapestries, pots, and all other sorts of other household goods. Since most settlers were landed farmers or petty chieftains, the quality of their stock was already high, and of those they brought only their best" (p.147).

The *Landnámabók* or "Book of Settlements," versions of which survive from late 1200s, was most likely written originally in the early 1100s. The book describes the founding and settlement of Iceland from the late 800s to the 1100s and includes 3000 individual names and 1400 places where they settled.

In 1905, Annandale published *Iceland and the Faroes: Studies in Iceland Life*. Almost 50 years before Watson and Crick discovered the structure of DNA, Annandale used *Landnámabók* to try to deduce the origin of the Icelandic horse. Per *Landnámabók*, the earliest settlers in Iceland came from two major groups. The majority of the first settlers were Norsemen, originally from Norway, who had occupied pockets of modern Britain including the Shetlands and Faroe Islands. They brought in "Westman" slaves from those islands and settled mainly in the south of the island. About 20 years later, a second batch of settlers, mostly nobles and their households, arrived either directly from Norway or after short stays in the northern Scottish islands, and settled in the north of Iceland. Annandale speculated that both groups brought Shetland pony type stock and Norwegian pony stock into Iceland.

Annandale also mentions that after the conversion of Iceland to Christianity in the early 1000s, Icelanders made pilgrimages to Jerusalem and that ambitious young men took service in the Varangian Guard, the personal bodyguards of the Byzantine emperor from the 9th to the 14th century. He concluded, "In short, it is probable that the original breed of horses in Iceland and the Faroes was of mixed origin, in which the Hebridean and the Scandinavian predominated, though blood from South Europe or even from the African and Asiatic coasts of the Mediterranean *may* [empasis added] have contributed to its formation" (p. 175).

Nordland horse. Trollvik Bjarke and Yme are Nordland geldings from the northern part of Norway, the area of origin of this horse breed. Norse who settled Iceland directly from Norway would have brought similar horses with them. Photo by Wenche Offerdal.

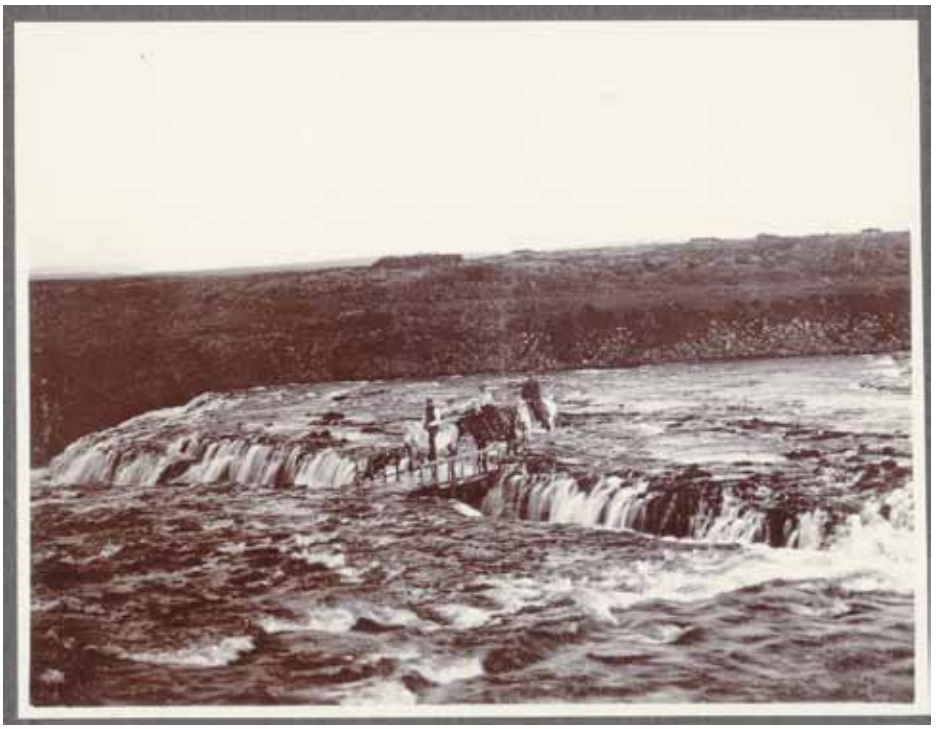
Annandale also highlights the resemblance between native Norwegian stock and the Mongolian pony.

So let's review some of the clues in trying to determine the source of the Icelandic horse. A reading of the historical sources suggests that early settlers to Iceland would have brought the best of their native stock from Norway and the northern British Islands to Iceland. The native stock of Norway probably had some overlapping breeding with the Mongolian pony. And travelers to the East and Spain may have brought back the occasional horse from an Eastern breed. The *Landnámabók* (Brown, 2001) mentions Kinnskaer, or White Cheek, a horse from Eastern Europe or Central Asia that had to be fed grain both summer and winter. So before checking the results of the latest mtDNA research on the Icelandic horse, let's examine how Icelandic horse keeping practices in the challenging Icelandic environment would influence the types of horses brought by the settlers.

ENVIRONMENTAL CONSTRAINTS

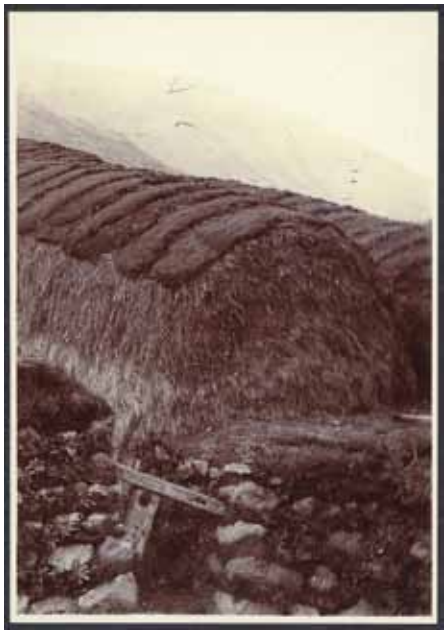
When the early settlers arrived in Iceland, they established most successful homesteads along the more hospitable coastline. Some of the island was uninhabitable—covered by glaciers (11%) and water (6%). The early settlers did find forests and arable land. However, Norse farming and husbandry practices had a devastating effect on the island's ecology. Between the time of settlement and today, almost all of the forest/brush (reduced from 25% to 1% of the surface area of Iceland) and most of the grasslands (reduced from 40% to 22%) were gone. Sterile wasteland increased from 18% to 58% of the island. Loss of topsoil, overgrazing, and too much grazing on the delicate highland fields led to even more ecological disasters (Byock, 2001).

In her investigation of historic Scandinavian horsekeeping practices from 500 BC to 1060 AD, A. Sunkvist discusses the practice common in many parts of Scandinavia, including Iceland, of maintaining free-roaming horse herds in which the majority of horses, when not under use, fend for themselves. Such practices led to "the survival of the fittest." As Sunkvist mentions, the Icelandic *Hrafnkel's Saga* and *The Saga of Gunnlaug Ormstungu* discuss how the mares are grouped with selected superior stallions in different valleys—a way of controlling breeding. She states that "the first law ever regulating horse-breeding in Iceland dates as late as 1891 and bans sexually mature colts [running] loose, which can be interpreted as a way to control the breeding." Certainly these methods were in use in Iceland until fairly recently and, when combined with the great change in Icelandic climate, had a devastating impact on the native horse populations during many years.



Icelandic is crisscrossed with rushing glacier streams. Any sort of travel in Iceland until modern times required a rock steady, sensible horse capable of navigating these tricky crossings. Photo by F. Howell, Cornell University Library.

Icelandic horses have always provided transportation across demanding terrain. Circa 1900, these travelers are crossing the glacier Breiðamerkurjökull. Photo by F. Howell, Cornell University Library.



Survival of any stock over winter in Iceland was dependent on how much hay could be harvested in the summer. Some of the better riding horses would have received additional care and forage. Haystacks were often roofed with sod to better preserve them. Photo by F. Howell, Cornell University Library.

From about 900 to 1200 AD, Iceland experienced a period of relative warm winters. From 1200 to 1920, the winters were much colder. Particularly bad winters during this time were give names such as "Horse Perishing Winter," "White Winter," and the "Great Snow Winter." Icelandic horses were sometimes fed herring to help them survive the winters. During the 19th century, 30% of the livestock died for every drop in average winter temperature of 1° C. As Björnsson and Sveinsson (2006) explain, "Horses learned that standing motionless, while the worst of the storm passed, made them burn fewer calories and protected them" (38). In addition, volcanic eruptions took their toll. A volcanic eruption in 1783 reduced the Icelandic horse population by 75% and was almost responsible for the island being abandoned. Only the hardiest and smartest Icelandic horses survived due to natural selection, and Icelandic farmers were often forced to cull the herds during catastrophic seasons.

When first settled, Iceland contained no large predators (other than the occasional polar bear that drifted onto the island and was quickly hunted down). The only native mammals were the small Arctic fox and the field mouse. However the Norse settlers themselves could be considered predators. Horses were sacrificed in pagan ceremonies both as funeral offerings and as offerings to the gods. Benjamen's (2008) comparison of Norse burial practices shows that "of the 316 known pagan graves from Iceland, 113 of them contained horses, which is an astonishing 36%. The ritual was probably introduced by Norwegian settlers, but the practice came to be more common in Iceland than it ever was in Norway (where a mere 7% of pagan graves contained horse burials)" (p. 8). Both men and women were buried with horses—although the practice was more common for men. In addition, horse meat was a staple for the early Icelanders until it was banned when Iceland converted to Christianity in 1000 AD (Brown, 2001). In modern Iceland, horse meat has returned to the dinner table.

Importation of additional livestock, including horses, was impacted by the scarcity of wood. After the initial settlement, Icelanders lacked the means to build many additional ships. Having harvested all trees, the Icelanders' only source for wood was driftwood that floated up on shore. As Byock (2001) explains, "Even for a journey down the coast, characters in the sagas most frequently resort to long overland horseback rides. An extensive system of horse paths connected the whole island. These led to almost every part of the country, and formed a highly serviceable communications web" (p. 46). Certainly fine riding horses became important in the day-to-day existence of Icelanders. And the lack of extensive road system in Iceland until the mid 1900s resulted in Icelanders continuing to breed for a tolting or ambling horse long after the rest of Europe started breeding only trotting horses.

As Byock (2001) concludes, "The Icelanders were fortunate in their horses. The original settlers imported small Scandinavian horses with thick coats. While continental Europeans bred their horses with Arabian stock in the 13th century to produce larger animals, the Icelanders continued with their small, tough horses, which over the centuries proved well adapted to North Atlantic conditions and Iceland's uneven terrain" (p. 28).

ICELANDIC HORSE MTDNA RESEARCH

Now let's examine how recent mtDNA research supports or contradicts what historical and saga references have suggested are the origins of the Icelandic horse. Jensen, Forster et al. (2002) extracted DNA from 318 unrelated horses representing 25 breeds from the U.S., Austria, Germany, Britain, Germany, Morocco, Spain, and Portugal. Each horse had to have documented ancestry for at last five generations. Additional mtDNA data was used from the GenBank or other publications, creating a total horse population of 652.

Using this data, the researchers were able to create 17 very frequent mtDNA types indicating relationship among breeds. As Jensen and Forster, et al., specify, "The clearest association between cluster and breed is evidenced by cluster C1 (n = 48): in our sample, it is geographically restricted to central Europe, the British Isles, and Scandinavia, including Iceland. A total of 17 of 19 documented horses with C1 are northern European ponies (Exmoor, Fjord, Icelandic, and Scottish Highland). Additionally, 14 of 27 undocumented horses with C1 are ponies, including Connemara ponies. The cluster is younger than perhaps 8,000 y[ears], but definitely older than 1,500 y, because C1 was also found in two ancient Viking horses. Furthermore, mtDNA cluster E (n = 16) consists entirely of Icelandic, Shetland, and Fjord ponies. Taken together, this suggests a common late glacial or postglacial origin for these pony breeds."

McCue, Bannasch, et al. (2012) conducted additional mtDNA research on samples representing 14 domestic horse breeds and 18 related species. They found that the Norwegian Fjord, Icelandic, Mongolian, and Belgian clustered together in three dimensions, and Icelandic and Norwegian Fjord horses clustered tightly together in all six dimensions. This may reflect the suggested influence of Mongolian genes in the development of the Norwegian Fjord and subsequent development of the Icelandic horse from Scandinavian stock imported to Iceland. Note that the researchers caution against including the Belgian, a draft breed, as being closely related to the Norwegian Fjord, Icelandic, Mongolian horses, since its history shows that it could have little

relationship to the other breeds.

Björnsson and Sveinsson (2006) present research that the Nordland, a rare Norwegian breed, is also very closely related to the Icelandic. These horses exhibit a very similar conformation and colors to the Icelandic horse and are also gaited. Björnsson and Sveinsson (2006) argue against including the Norwegian Fjord as a direct ancestor of the Icelandic horse, since the conformation and singular coloring of the breed is so different from the conformation and multiple colors of the Icelandic breed.

In summary, recent mtDNA research confirms that the Icelandic horse is closely related to pony breeds such as the Exmoor, Scottish Highland, and Shetland from the northern British Isles, confirming that ancestors of these breeds were brought to Iceland by Norse settlers from these areas. In addition, solid evidence exists that ancestors of the Nordland and Norwegian Fjord were brought by the initial settlers of Iceland from Norway. Norse trading centers in modern-day Sweden had very close trading contacts with what is now Russia, which would help explain the influence of the Mongolian horse on the Norwegian breeds.

Current mtDNA studies show no relationship to the Spanish or Arabian breeds. Certainly, early horse-keeping practices in Iceland would not have supported the feeding of daily grain and hay required by these Eastern breeds for their survival in the harsh conditions of Iceland. Today the Icelandic horse is regarded as a national treasure. Hopefully this review of the history, cultural, and environment factors that led to the development of the Icelandic horse have helped to explain why "The horse is often called Iceland's best ambassador, an appropriate title as foreigners have fallen in love with it so completely that there are now more Icelandic horses abroad than in Iceland" (Björnsson and Sveinsson, 2006, p. 286).

Until modern times, horses in Iceland typically had to fend for themselves with minimal care over the winter. These horses are grazing near Stórólfshvol in Iceland around 1900. Photo by F. Howell, Cornell University Library.

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