

Comparison of genomic signatures of selection in Icelandic horses and Exmoor ponies

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Background

- The Icelandic horse
 - **Past:** Old native breed shaped by its small founding gene pool, geological isolation, bottlenecks and harsh environment
 - **Present:** Strong artificial selection with a focus on performance and gaits
- The Exmoor pony
 - **Past:** Old native, semi-feral breed shaped by severe bottlenecks and harsh environment
 - **Present:** A breeding program focused on conservation and preserving exterior characteristics



www.sydraskordugil.is / Photo Tanja Davis



www.devonlive.com / Photo Geoff Baylis

Comparison

- Similarities
 - Easy keepers, low energy requirements
 - Size and body structure
 - Winter coat
- Differences
 - Recent breeding goals

- Hypothesis

- These breeds share some signatures of natural selection for adaptation, whereas signatures of artificial selection for performance would be specific for the Icelandic horse



1) www.commonswikimedia.org / Photo Mark Robinson, 2) www.classiciceland.com,
3) www.horseandhound.co.uk / Photo Helen Revington, 4) www.facebook.com/icelandicstallion8.95WR

Material & Methods

380 Icelandic horses

274 Exmoor ponies

670K Axiom Equine Genotyping Array

- 550,405 shared autosomal SNPs

Runs of homozygosity (ROH) analyzed with detectRUNS package in R

- ROH = continuous homozygous segments resulting from reduced genetic variability due to selection
- “Signatures of selection”

Material & Methods

ROH settings

- sliding window approach
- maximum distance between consecutive SNPs equal to 100 kb
- minimum SNP density equal to 0.05 SNP/kb
- minimum number of SNP in a run equal to 10
- minimum length of a run equal to 100 kb
- one missing and one heterozygous SNP was allowed per run

The settings allowed ROH detection for 99.4% of the autosomal genome

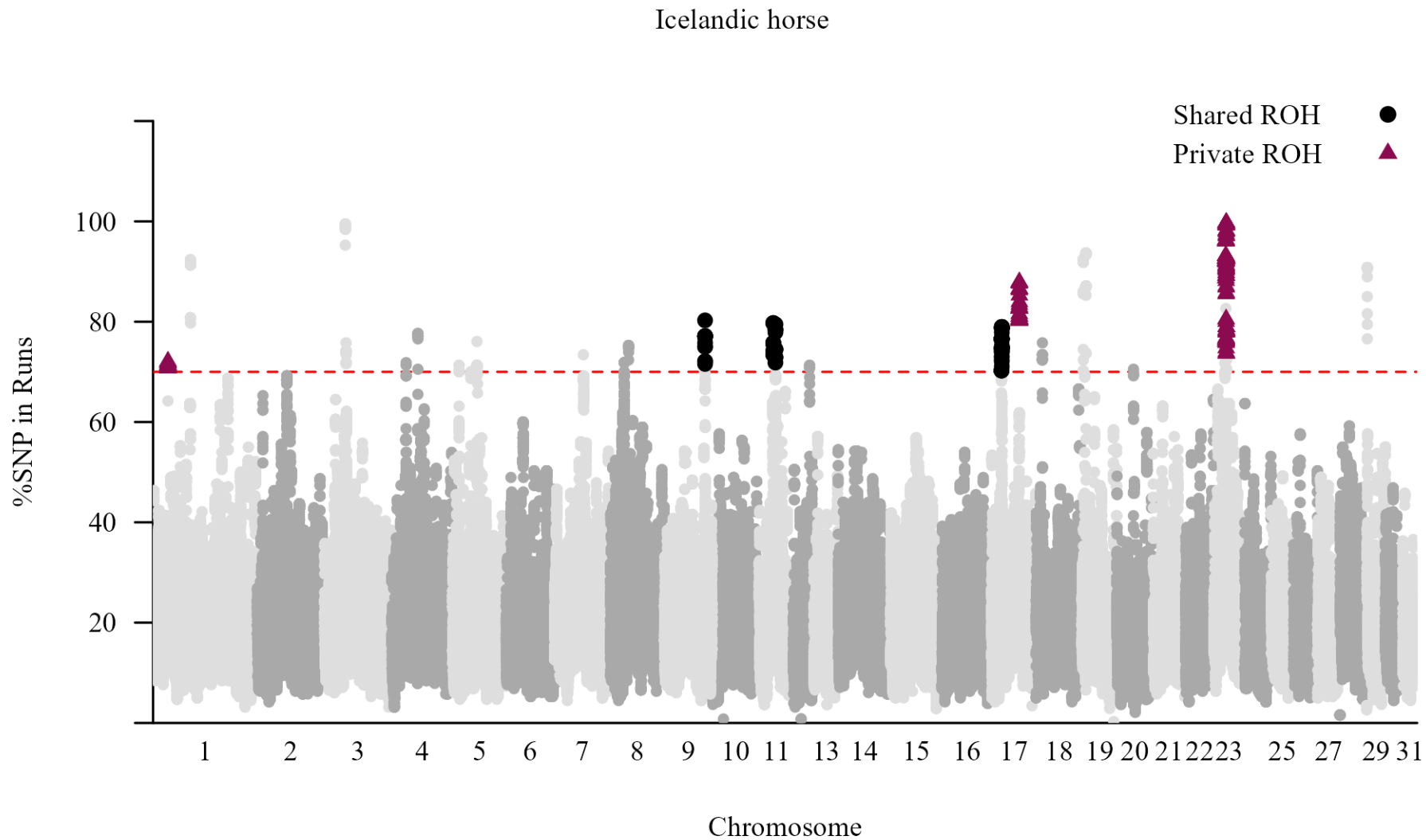
ROH islands that were shared by over 70% of the horses were determined as signatures of selection

Results

Icelandic horse



www.eidfaxi.is / Krókur frá Ytra-Dalsgerði



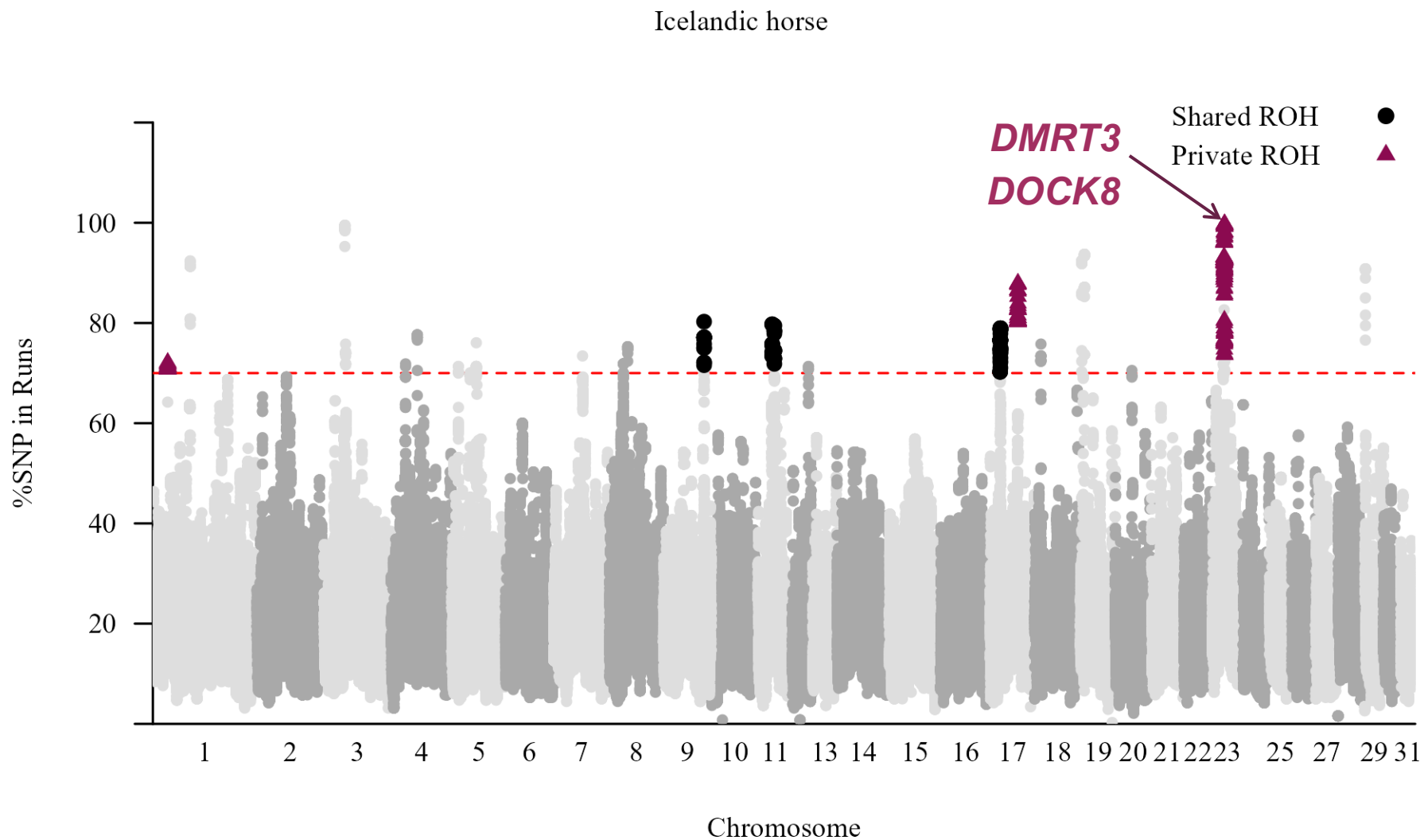
a.

Results

Icelandic horse



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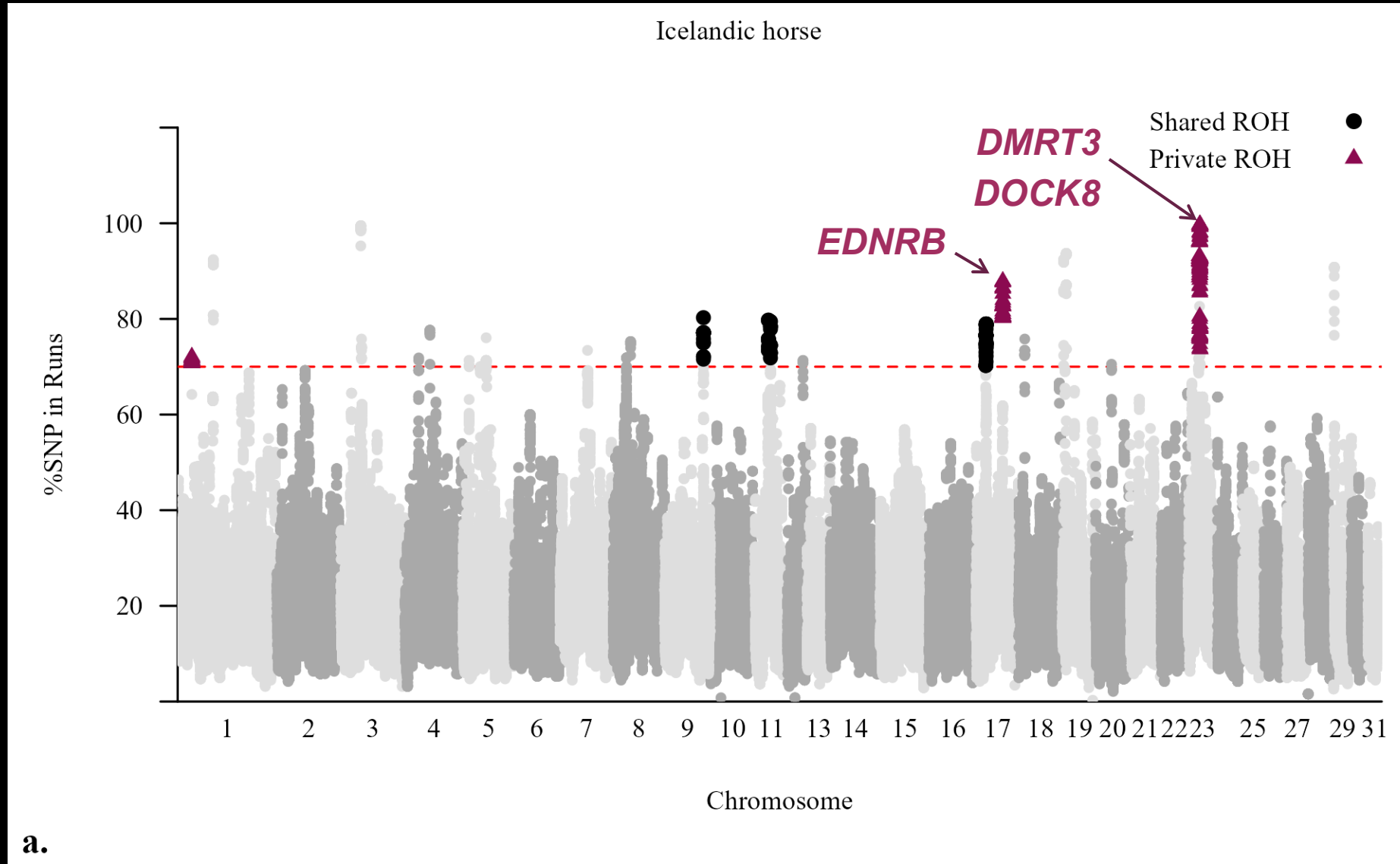
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Results

Icelandic horse



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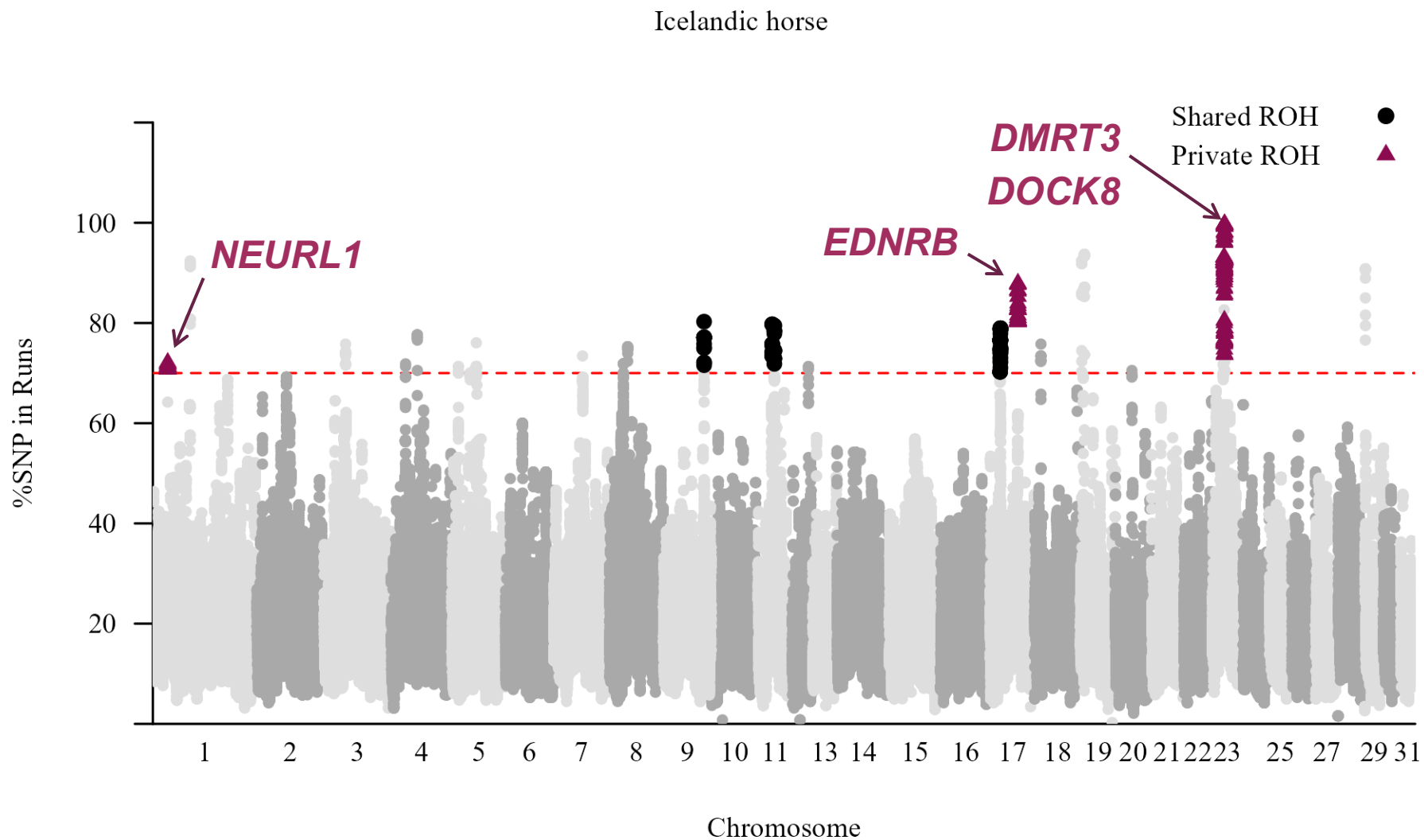


Results

Icelandic horse



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a.

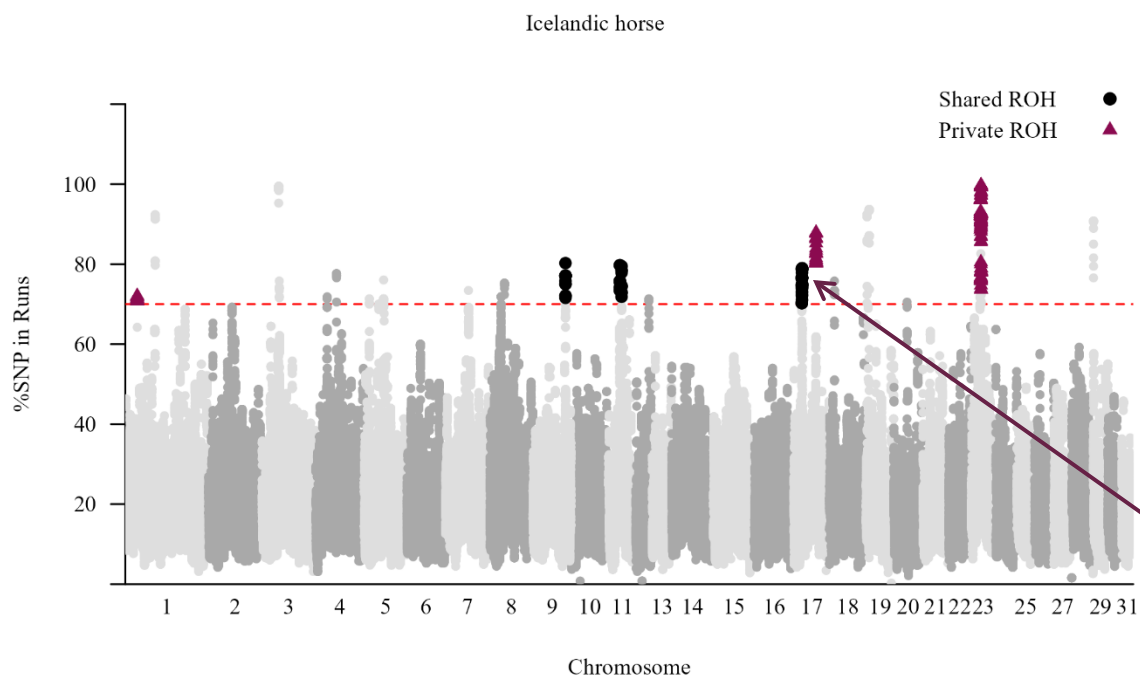
Results

Shared ROH islands

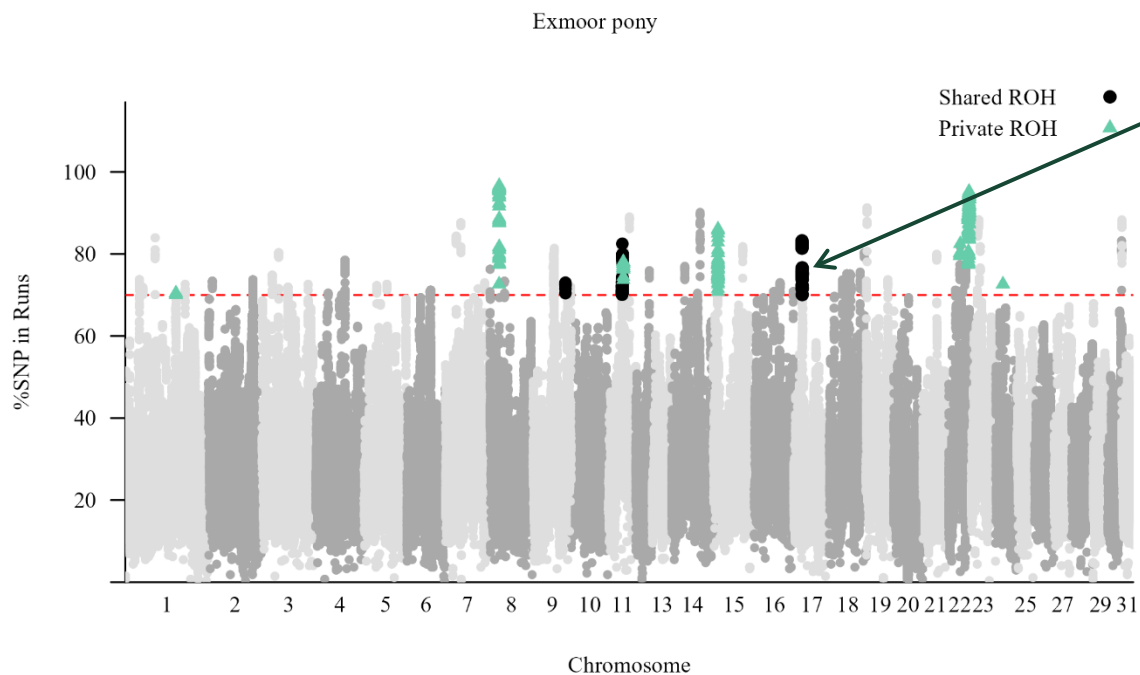


www.facebook.com/suttonparknrr

a.



b.



www.iceland-photo-tours.com / Photo Iurie Belegurschi

FOXO1

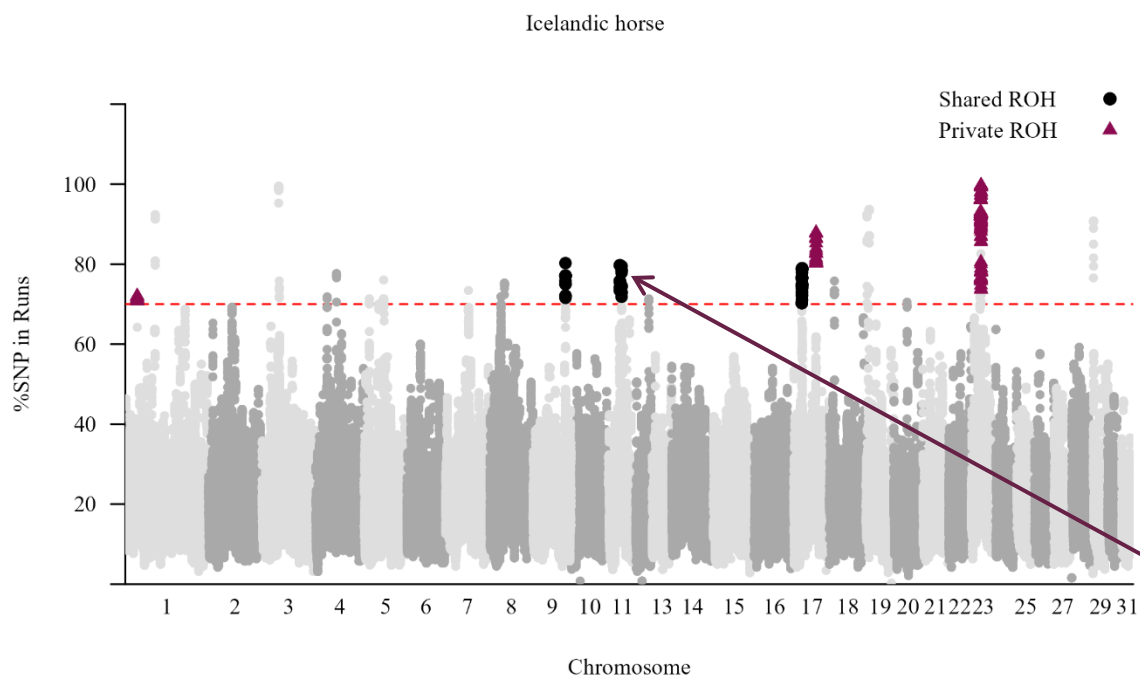
Results

Shared ROH islands

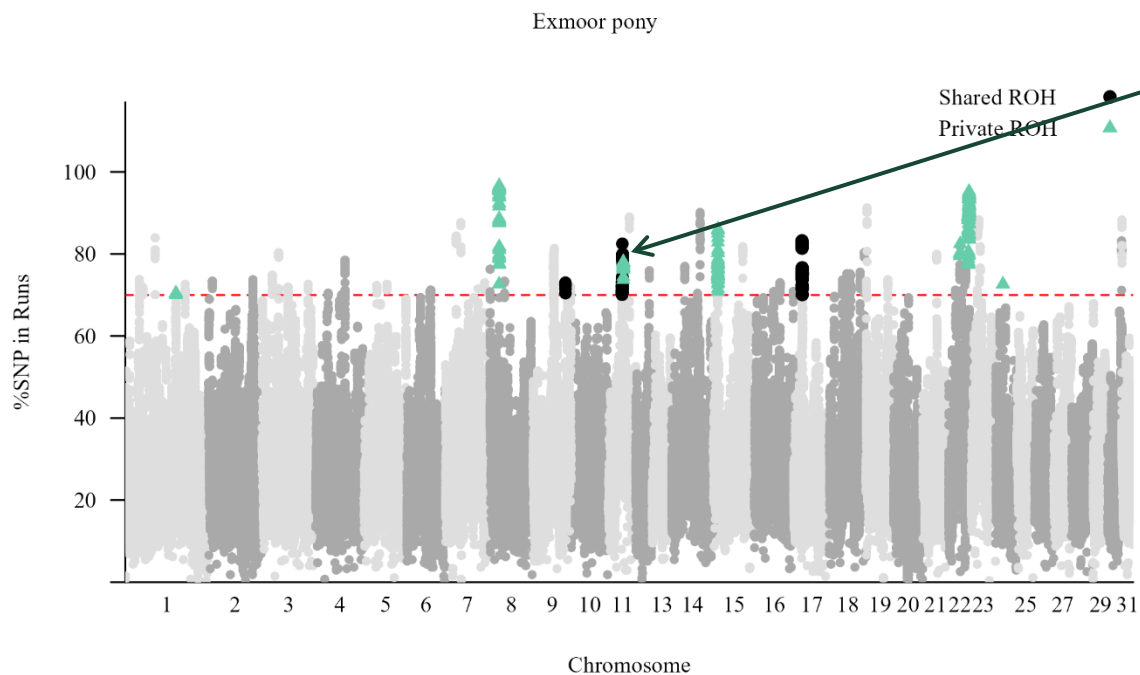


www.icelandmag.is / Photo Vilhelm Gunnarsson

a.



b.



www.guidetoiceland.is / Photo Jörunn Sjöfn



www.earthisland.org / Photo Thomas Haeusler

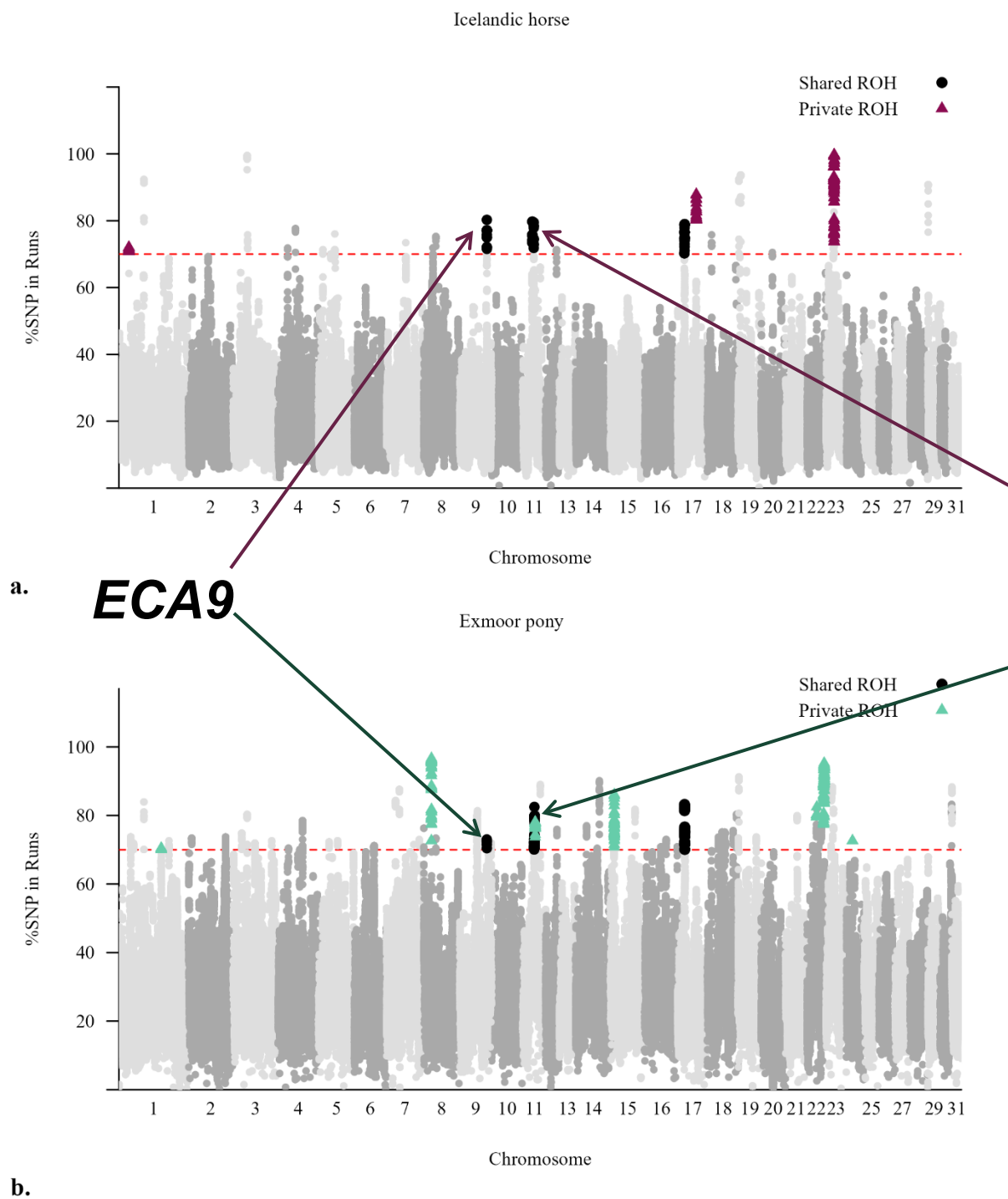
ECA11

Results

Shared ROH islands



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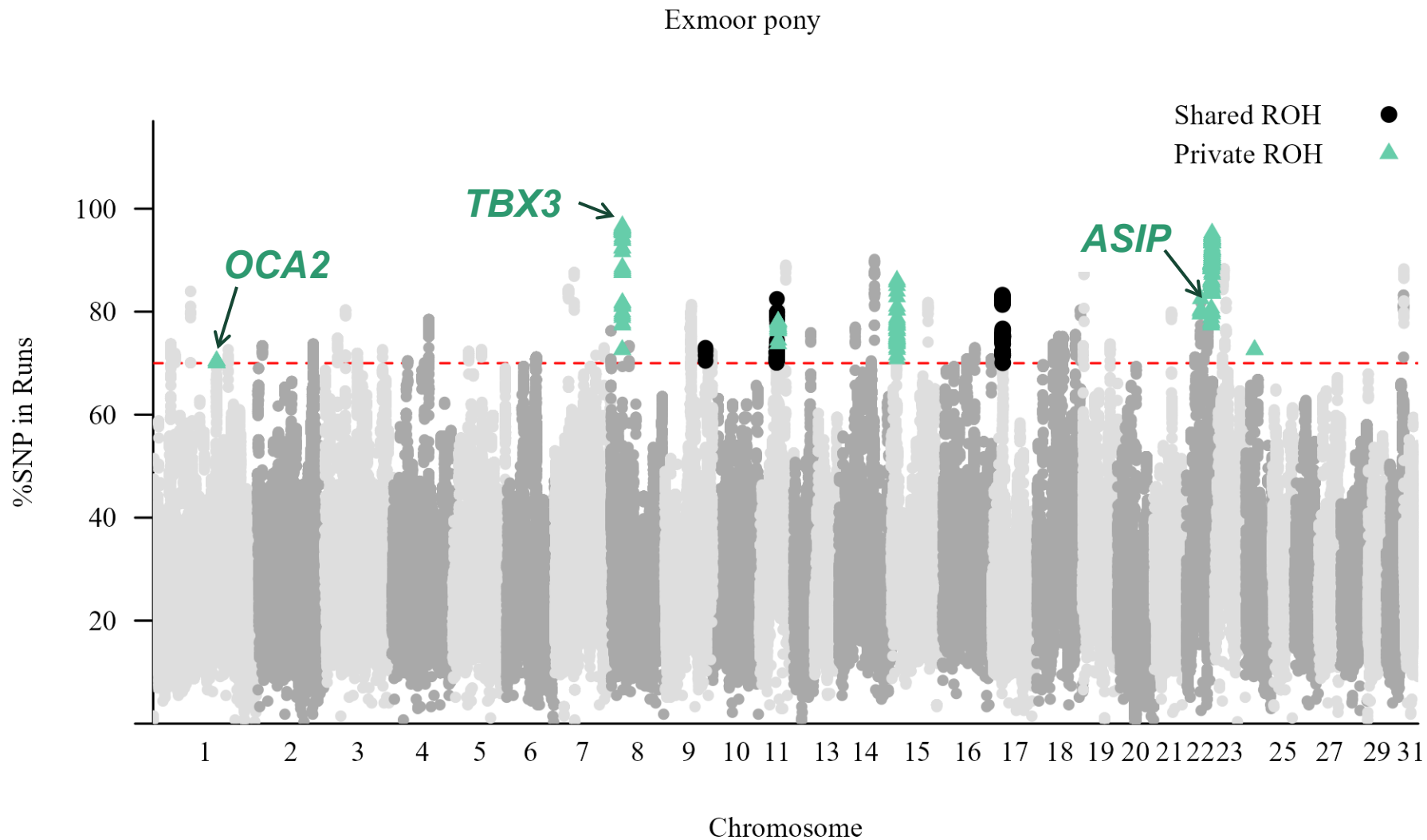
www.earthisland.org / Photo Thomas Haeusler

Results

Exmoor pony



www.anchorexmoorponies.co.uk



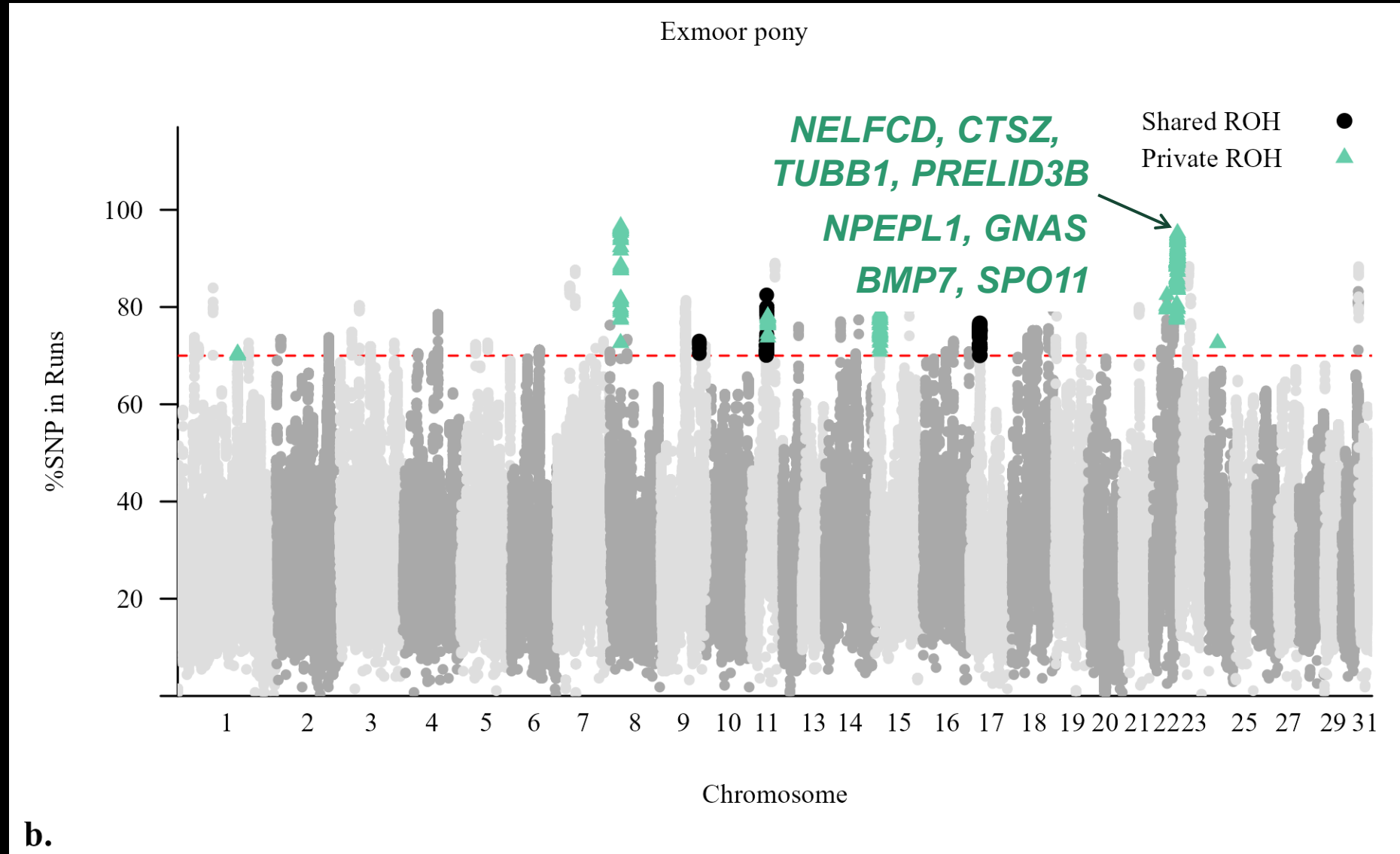
b.

Results

Exmoor pony



www.anchorexmoorponies.co.uk

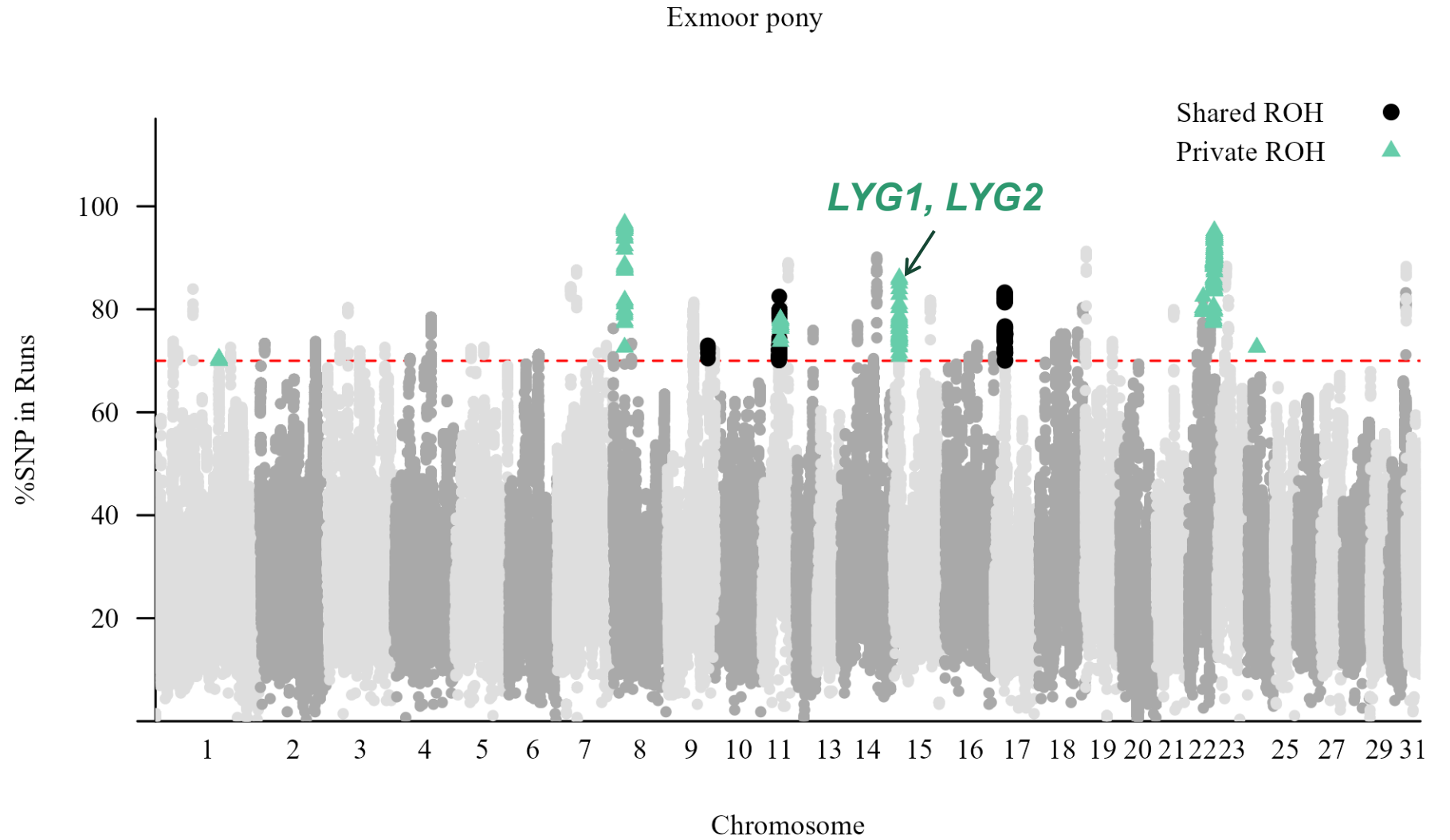


Results

Exmoor pony



www.anchorexmoorponies.co.uk



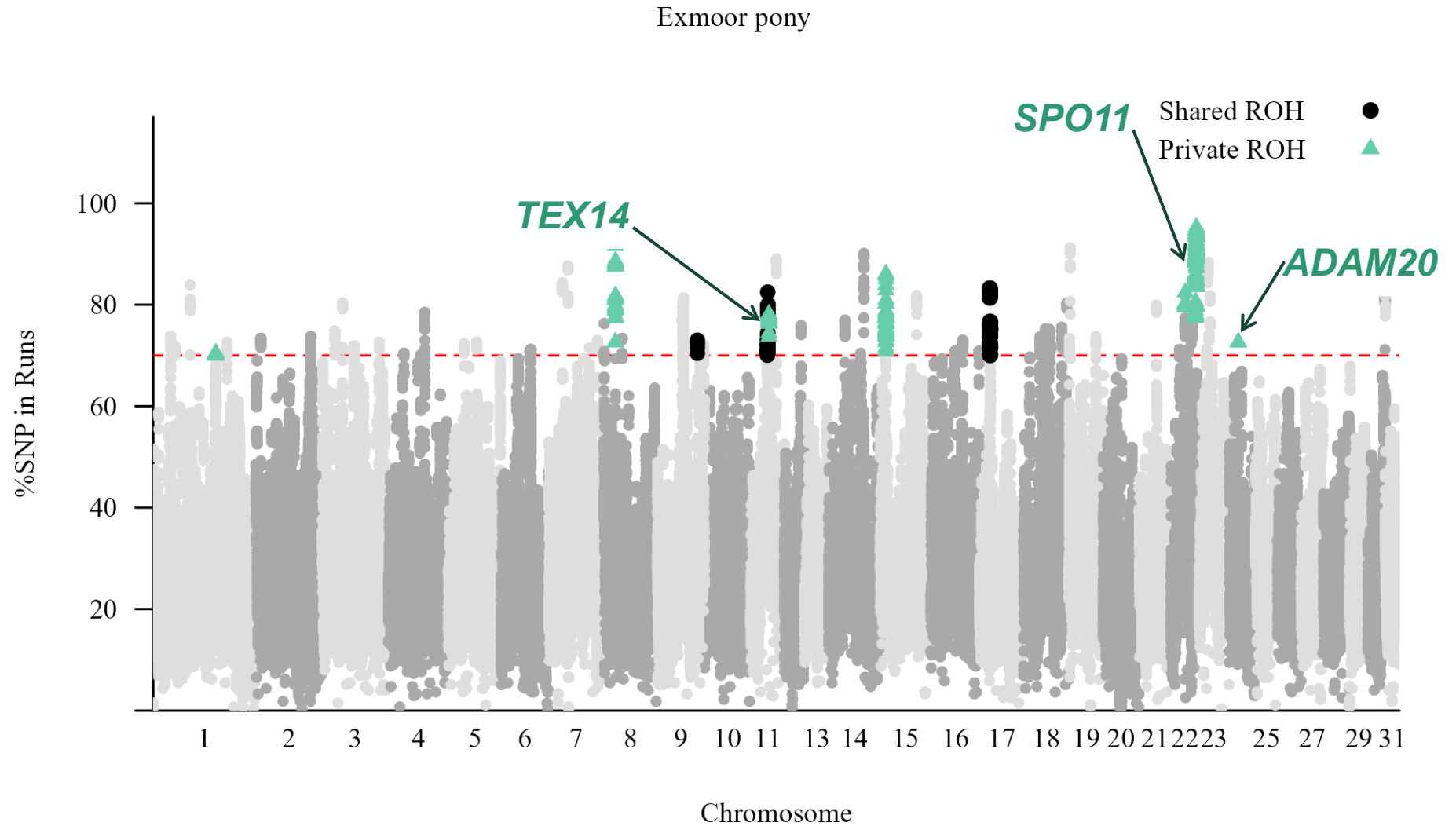
b.

Results

Exmoor pony



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b.

RESEARCH

Open Access

Genetic diversity and signatures of selection in Icelandic horses and Exmoor ponies

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Take home message

- Signatures related to performance in the Icelandic horse
- Signatures related to adaptive traits shared by the two breeds:
 - Harsh conditions; poor feed and cold weather
 - Immune response
- Signatures related to coat color, blood regulation/hypertension, immune response and fertility in Exmoor ponies
- **Results provide important insight into genomic regions shaped by natural selection, as well as regions shaped by recent artificial selection for performance**

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Thank you for your attention!



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The Icelandic Horse Population
Conservation Fund



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