

Genetics of extreme body size evolution in mice from Gough Island

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bit.ly/CTC2014

This is a collaboration with Bret Payseur (Genetics, UW-Madison).

Gough Island is a small, isolated island in the South Atlantic. The mice on the island are considerably larger than mainland wild mice. We are seeking to dissect the underlying genetic mechanisms for this difference.

Gough Island



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Gough Island is an isolated island in the South Atlantic, about half-way between South America and Africa.

Big rodents



The Island Rule



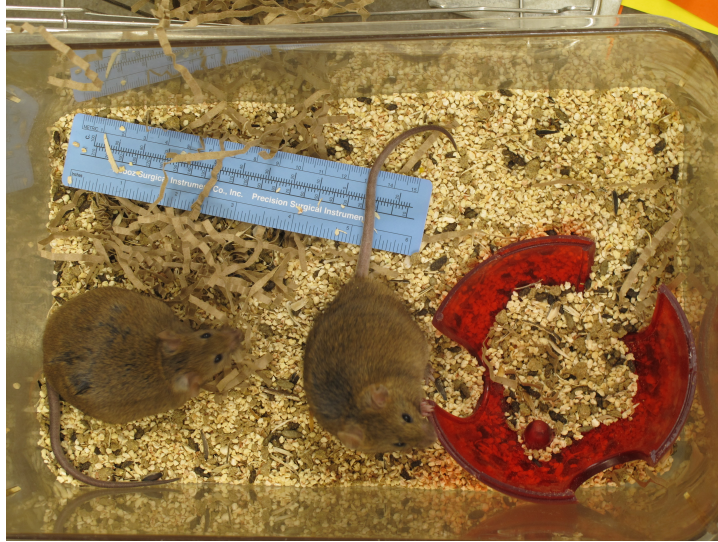
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The “Island Rule” is that after colonizing an island, animals less than 1 kg tend to get bigger, and animals greater than 1 kg tend to get smaller.

On the left are a pair of fox skulls. The larger one is a mainland fox; the smaller one is an island fox.

On the right are a pair of scrub jays. The smaller one is a mainland jay; the smaller one is an island jay.

Gough mice



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This is a pair of Gough mice raised in the lab.

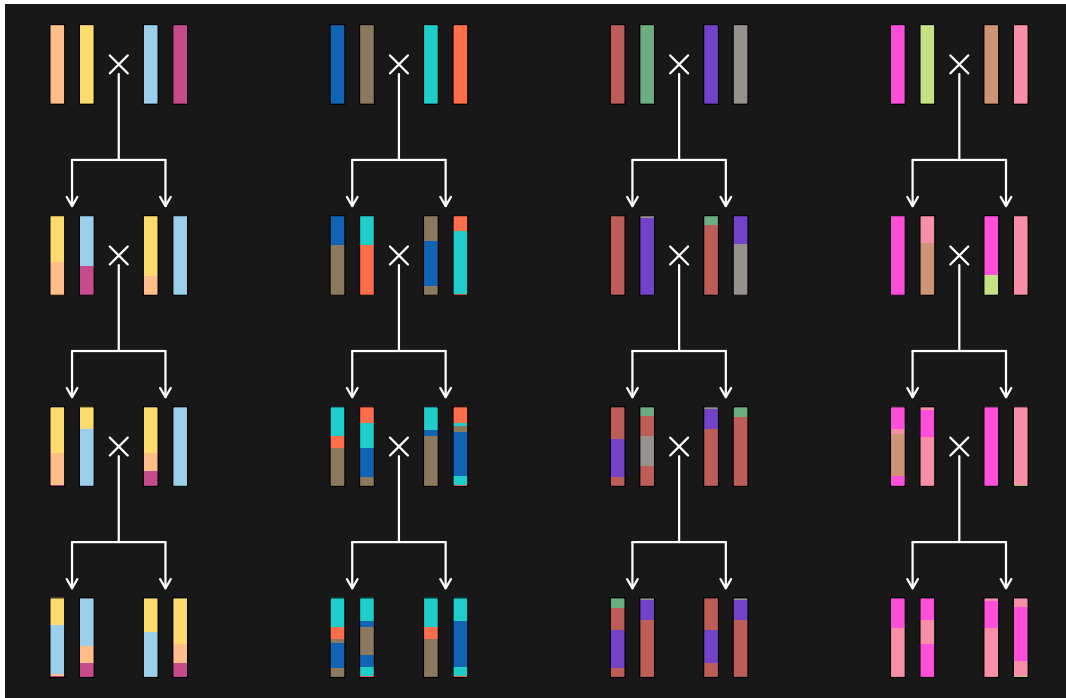
WSB and Gough mice



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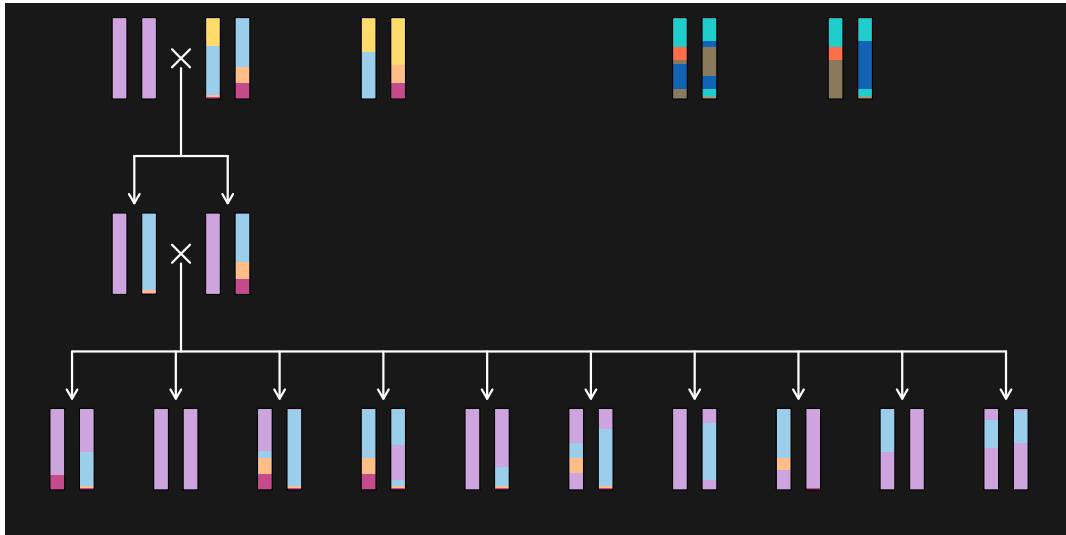
Here is a WSB mouse (left) next to a Gough mouse (right).

Partially-inbred Gough lines



Bret Payseur's lab is in the process of developing a set of inbred strains derived from Gough mice.

Gough × WSB crosses

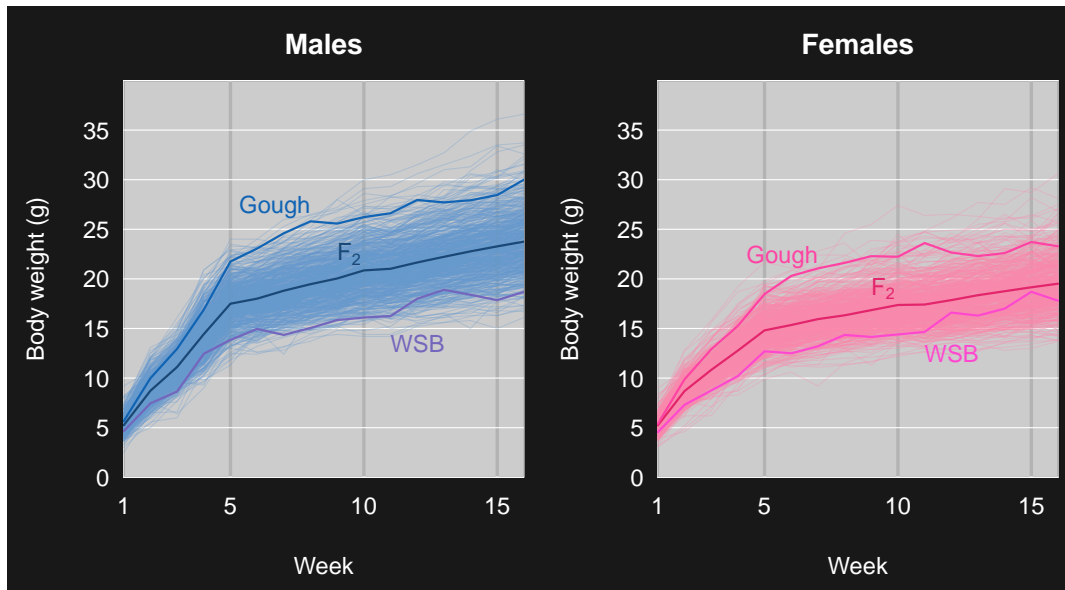


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In order to identify the genes that contribute to the larger size of Gough mice, we're considering data from four large intercrosses, each between a Gough mouse (after three generations of inbreeding) and an inbred WSB mouse. There are a total of 1212 mice from four crosses.

The mice were genotyped with the MegaMUGA SNP array. For now, we're focusing on 11833 SNPs that are fixed in Gough, and so segregate like a standard F_2 intercross between inbred strains.

Growth curves

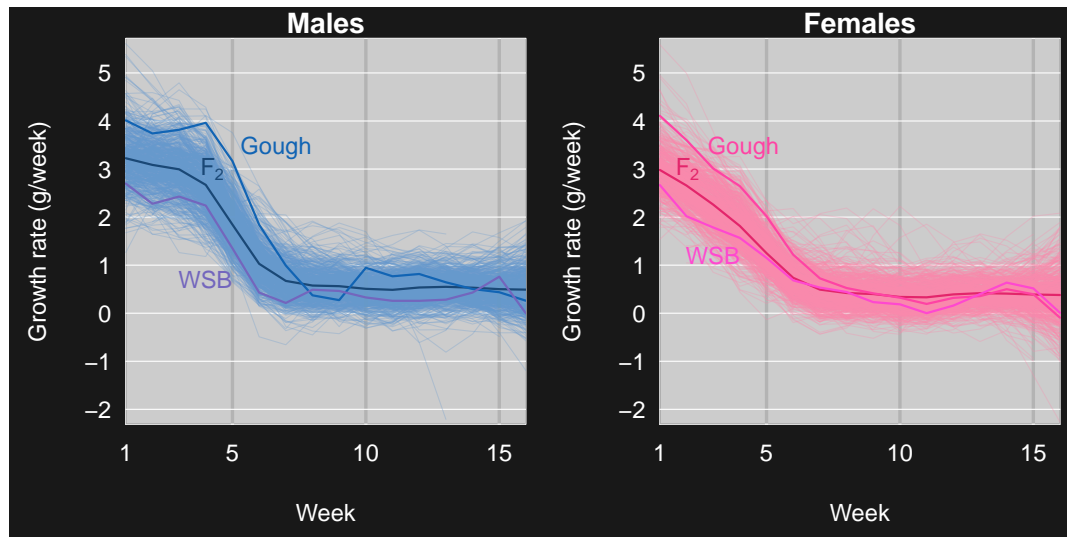


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We don't have too much data on the body weights of the Gough and WSB parents, but they do show large differences.

We've measured body weight for each F₂ mouse, weekly, at ages 1–16 weeks. There is a large sex difference and considerable individual variation.

Growth rate

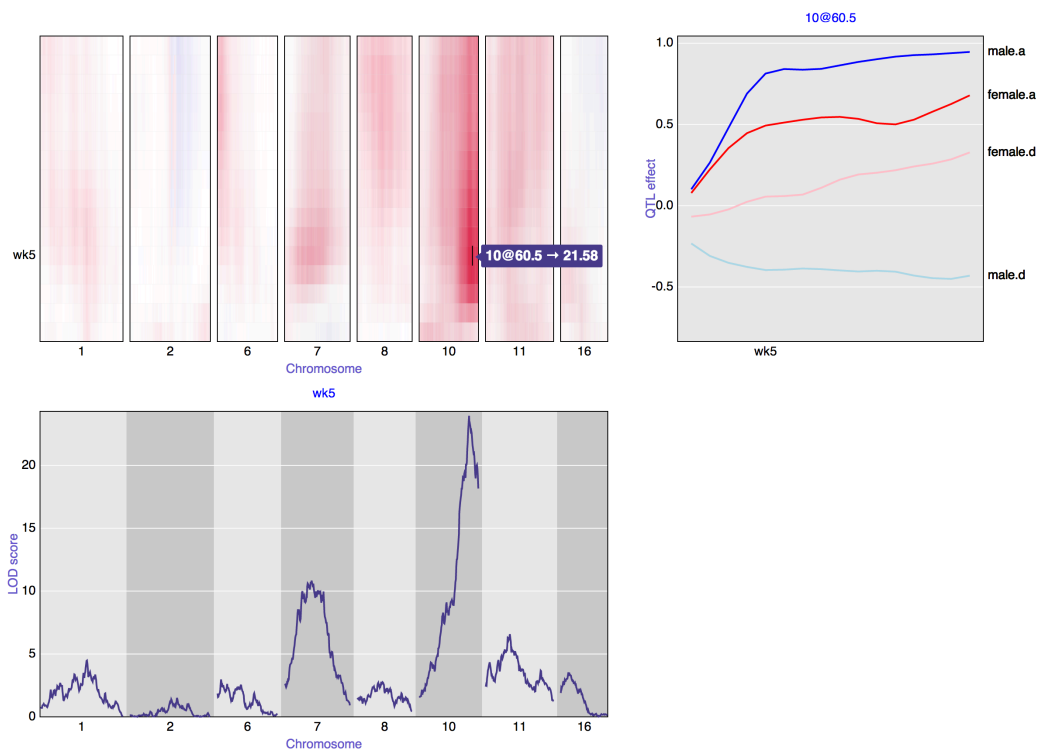


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The estimated growth rate (the first derivatives of the body weight curves) are particularly interesting: high initial rate that slows during weeks 4–7 and then is flat thereafter.

The estimated average growth rates for the Gough and WSB parents are quite noisy, but it does seem that the biggest differences are in the initial growth, in weeks 1–5.

Genome scan for body weight



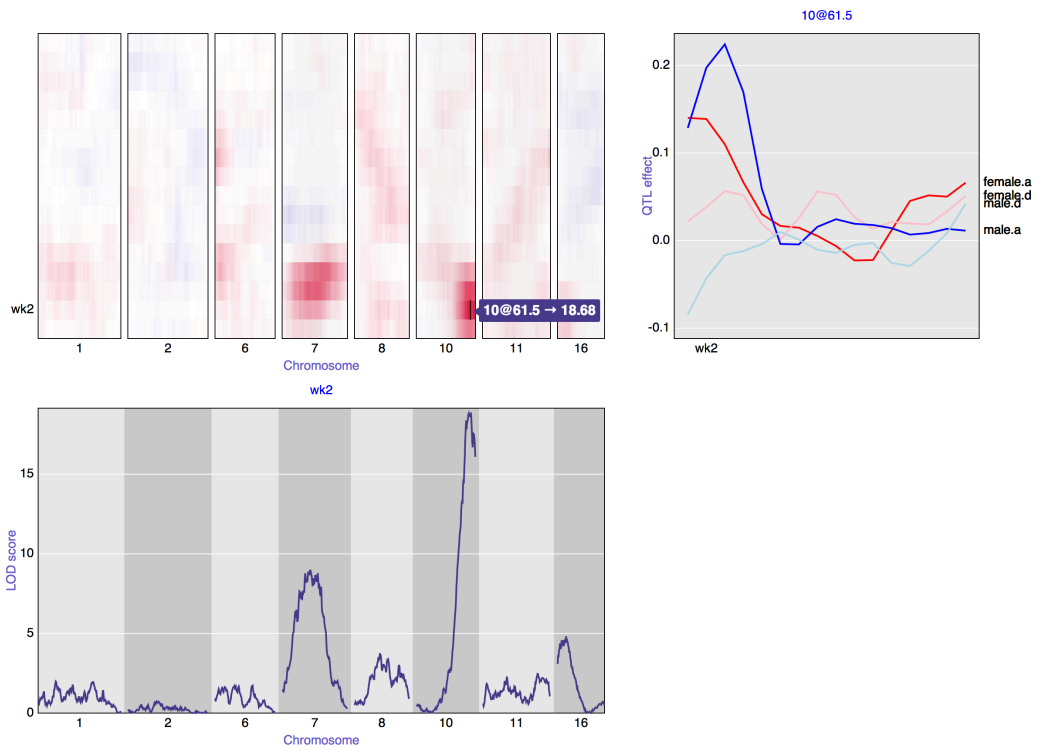
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These are the results of genome scans for body weight, considering each time point individually. It is a snapshot of an interactive graph produced with R/qtcharts bit.ly/rqtcharts.

The top-left panel is a heat map of the LOD scores for selected chromosomes, with red indicating that the Gough allele causes increased body weight and blue indicating that the Gough allele causes decreased body weight. In the interactive version, if you hover over a point in the top-left panel, the LOD curves at that time point are shown below, and the estimated QTL effects as a function of time are shown on the right.

Strong QTL are seen on chr 7 and 10.

Genome scan for growth rate



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These are analogous results to the previous slide, but for growth

The QTL on chr 7 and 10 are seen to affect growth rate in weeks 2–5.

Summary

- ▶ Multiple QTL contributing to body size in Gough × WSB.
- ▶ Gough alleles result in increased size.
- ▶ The major effects are on growth rate in first five weeks.
- ▶ Interactive graphs with R/qtcharts, bit.ly/rqtcharts

A summary of the main points.

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