

Purging of Strongly Deleterious Mutations Explains Long-Term Persistence and Absence of Inbreeding Depression in Island Foxes

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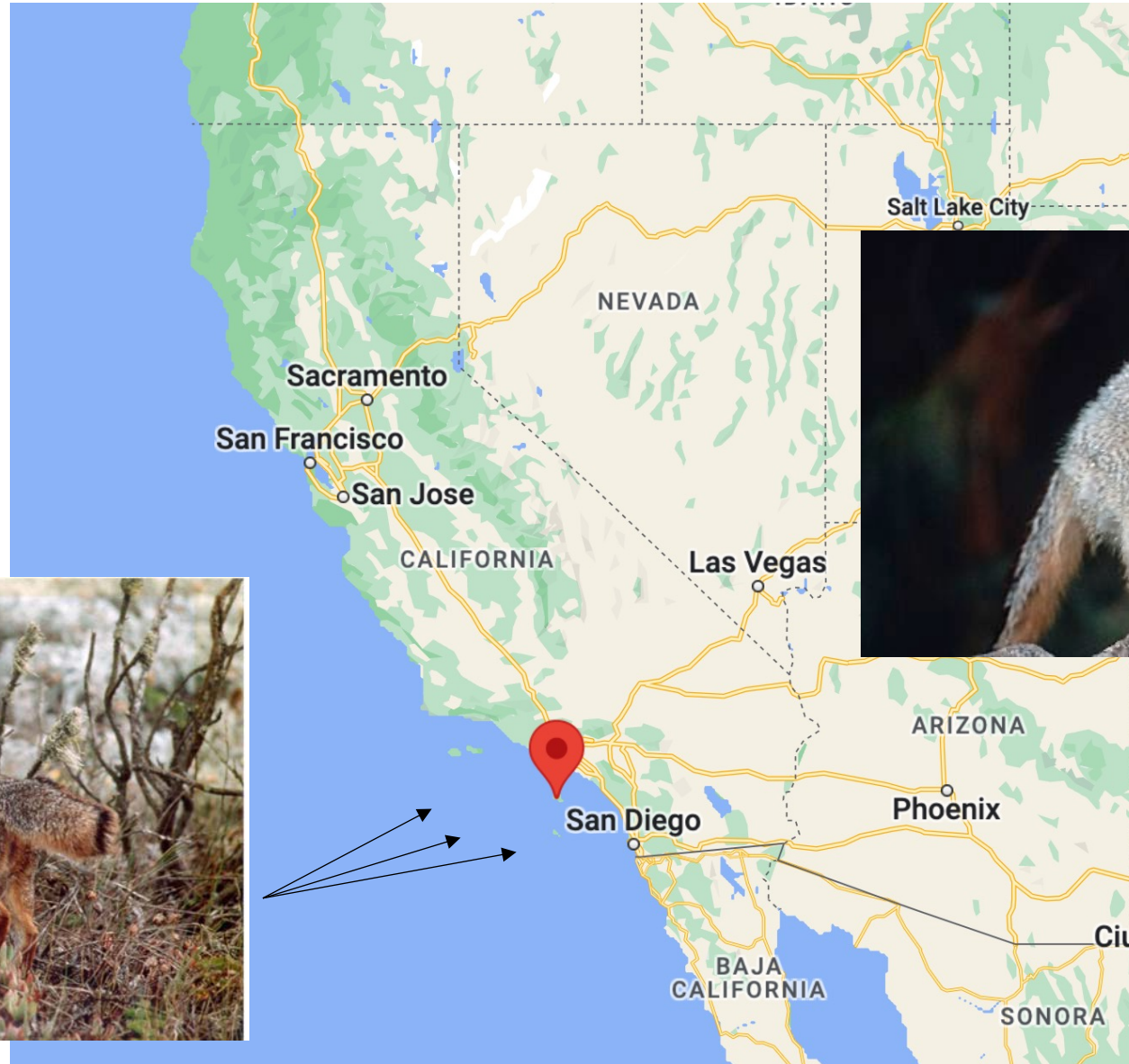
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Island foxes!!!

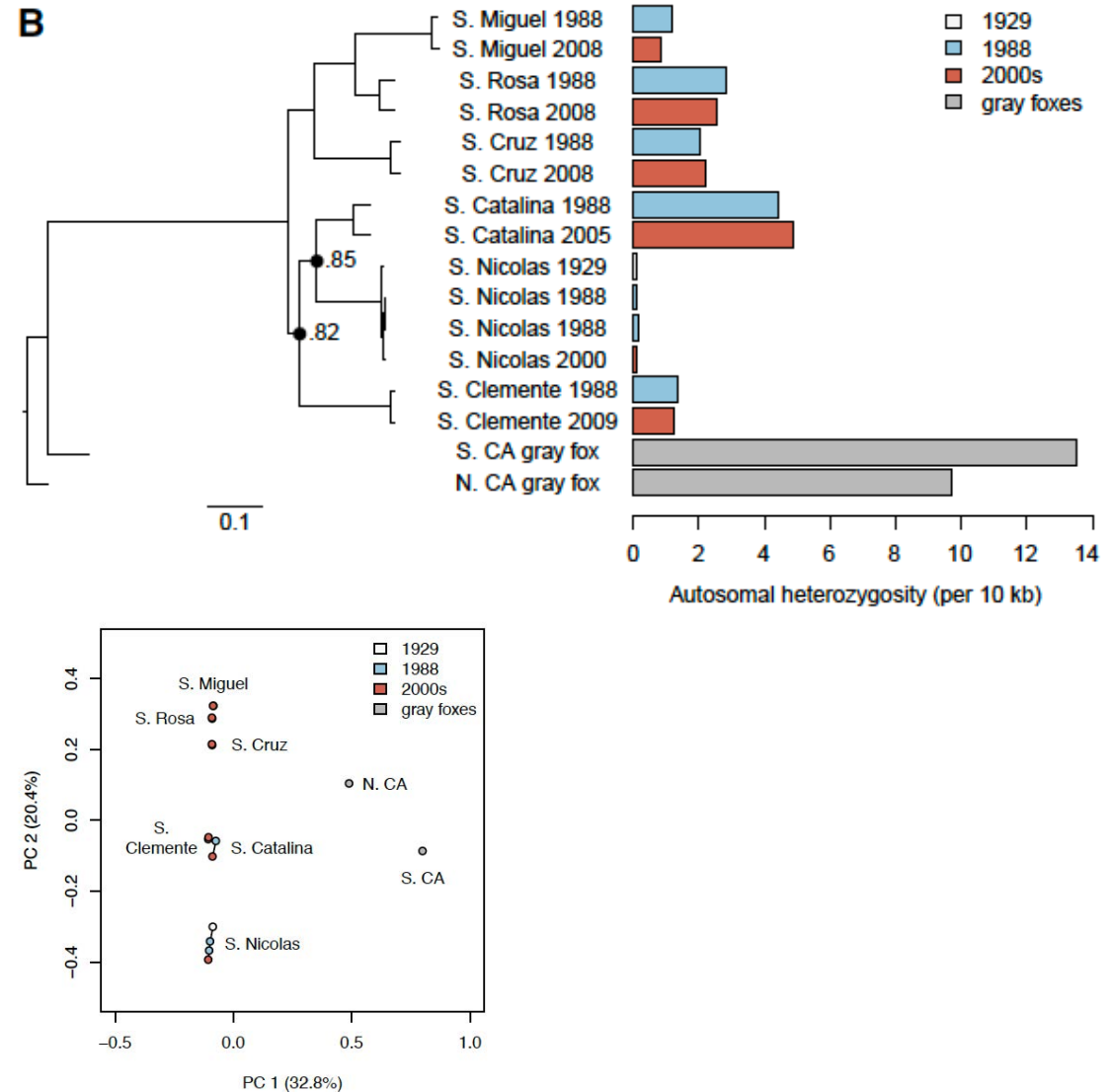
Island fox



Mainland fox

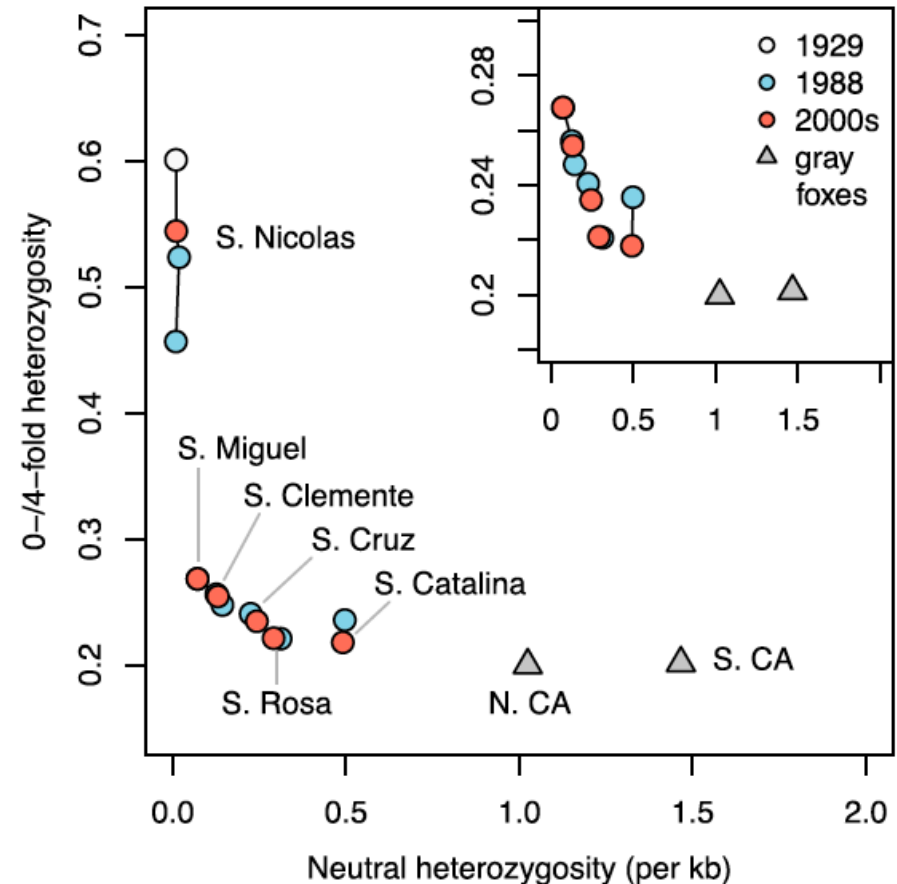
Genomic Analysis

- Whole Genome Sequencing:
 - 16 foxes 13X-23X Illumina
 - Mapped to dog reference genome
 - Called variants with freebayes
- Maximum likelihood phylogeny:
 - Based on 12,249 SNPs
 - Pruned for linkage disequilibrium
- Also, PCA analysis



Genomic Analysis

- Y-axis: Ratio of zero-fold relative to four-fold degenerate sites (proxy for selection)
- X-axis: Neutral heterozygosity
- Island foxes contain a high proportion of amino-acid changing mutations and low genetic diversity



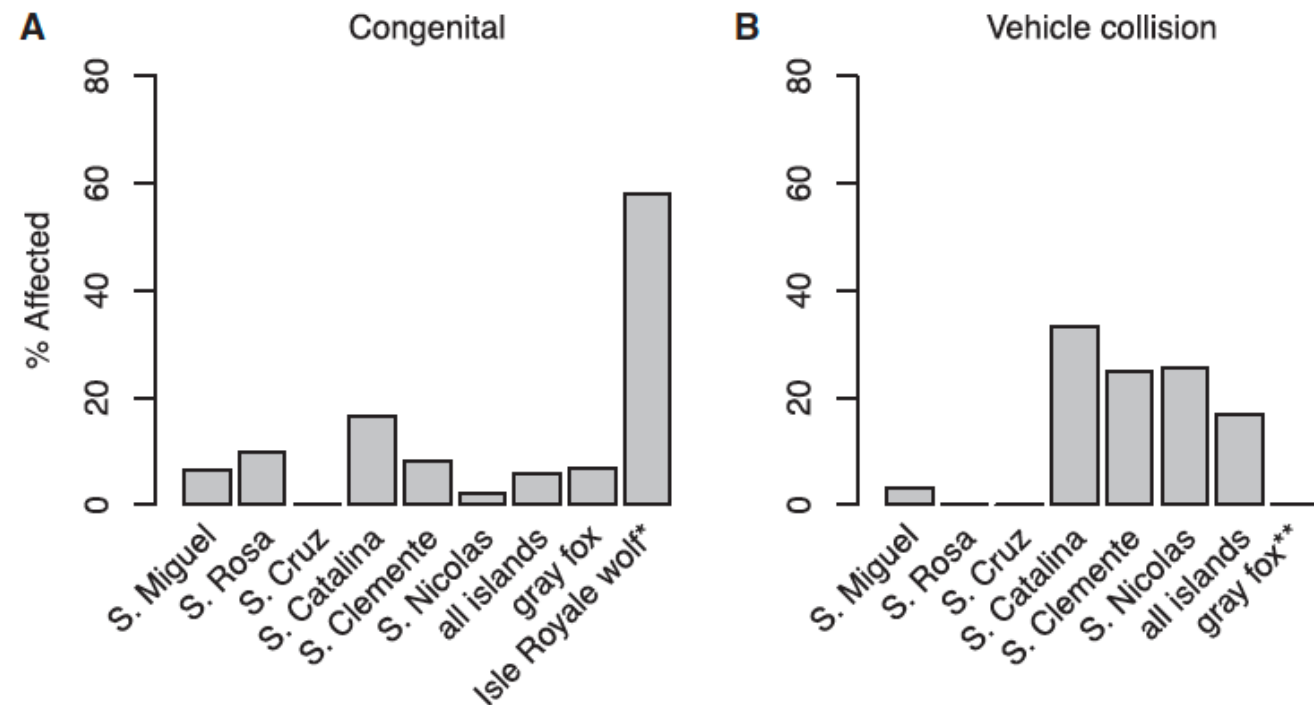
Still, not a lot of congenital defects in island foxes relative to other wild canids (dogs)!

From museum collections:

141 skulls

163 complete specimens

Checked for malformations or injuries



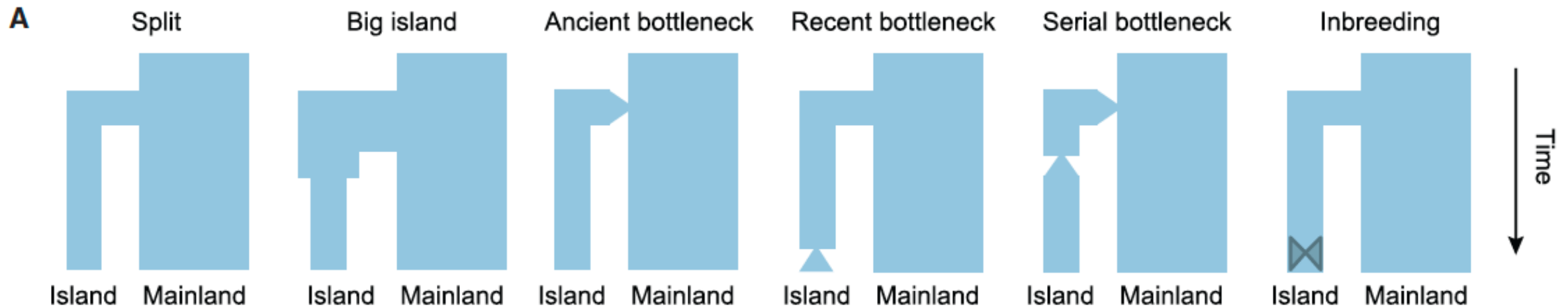
Island foxes are far more susceptible to death by vehicle collision.

Inbreeding depression doesn't seem to be an issue.

Why?

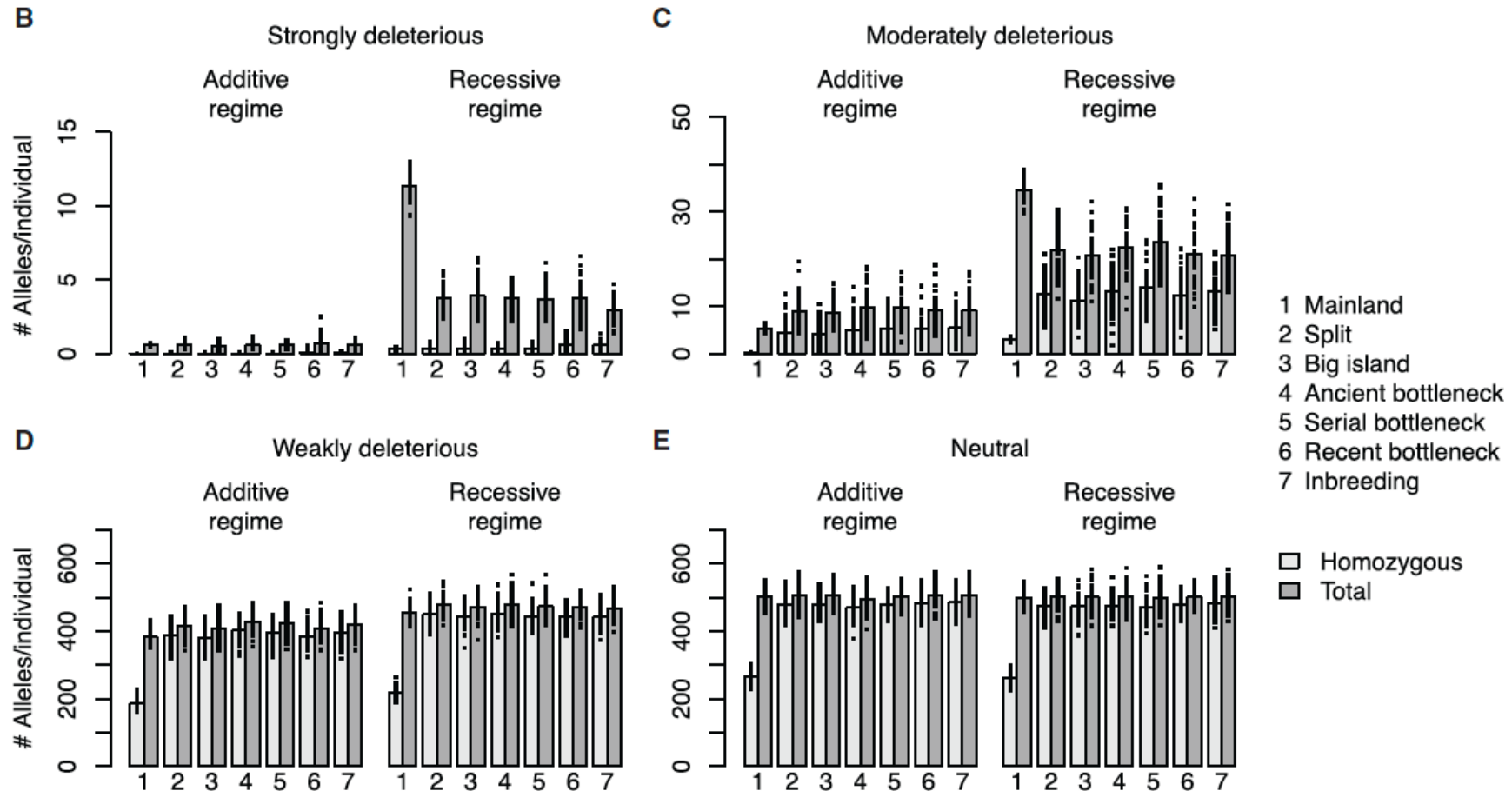
Simulations of Neutral and Deleterious Genetic Variation

- Six different models involving the establishment of a small island population from a large mainland population



- Each model produced a 2Mb diploid genome, consisting of annotated “genes” = $\sim 1/10^{\text{th}}$ the dog genome.
- They then counted the deleterious (weak and strong) and neutral mutations.

Simulations produced a dearth of strongly deleterious mutations in island populations compared to mainland populations



Conclusions

- Bigger (population) is not necessarily better!
- Excessively deleterious alleles are exposed to selection in small populations and are purged from the population
- Meanwhile, weakly deleterious alleles can drift to high frequency.
- This explains why Island foxes have low genetic diversity but are not suffering from inbreeding depression.
- Instead, they are getting hit by cars 😞