

# The Imminent Extinction of the Australian Dingo

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## INTRODUCTION

The Australian Dingo is in danger of extinction due to the introgression of dog genes. In the wild the Dingo is gradually being replaced by feral dogs and dingo/dog hybrids.

The Dingoes and domestic dogs interbreed freely and produce fertile hybrid offspring. Dingo is a domestic dog as they were 5,000 years ago (Savolainen et al PNAS 101: 12387, Aug, 2004).

It is estimated that only 20% of the dingo population on the south east of Australia is pure.

Traditional methods of distinguishing dog and dingoes are morphological measurements on skull and coat colour. There are also physiological and behavioural differences eg breeding cycles, vocalisation.



Dingo or Dog?

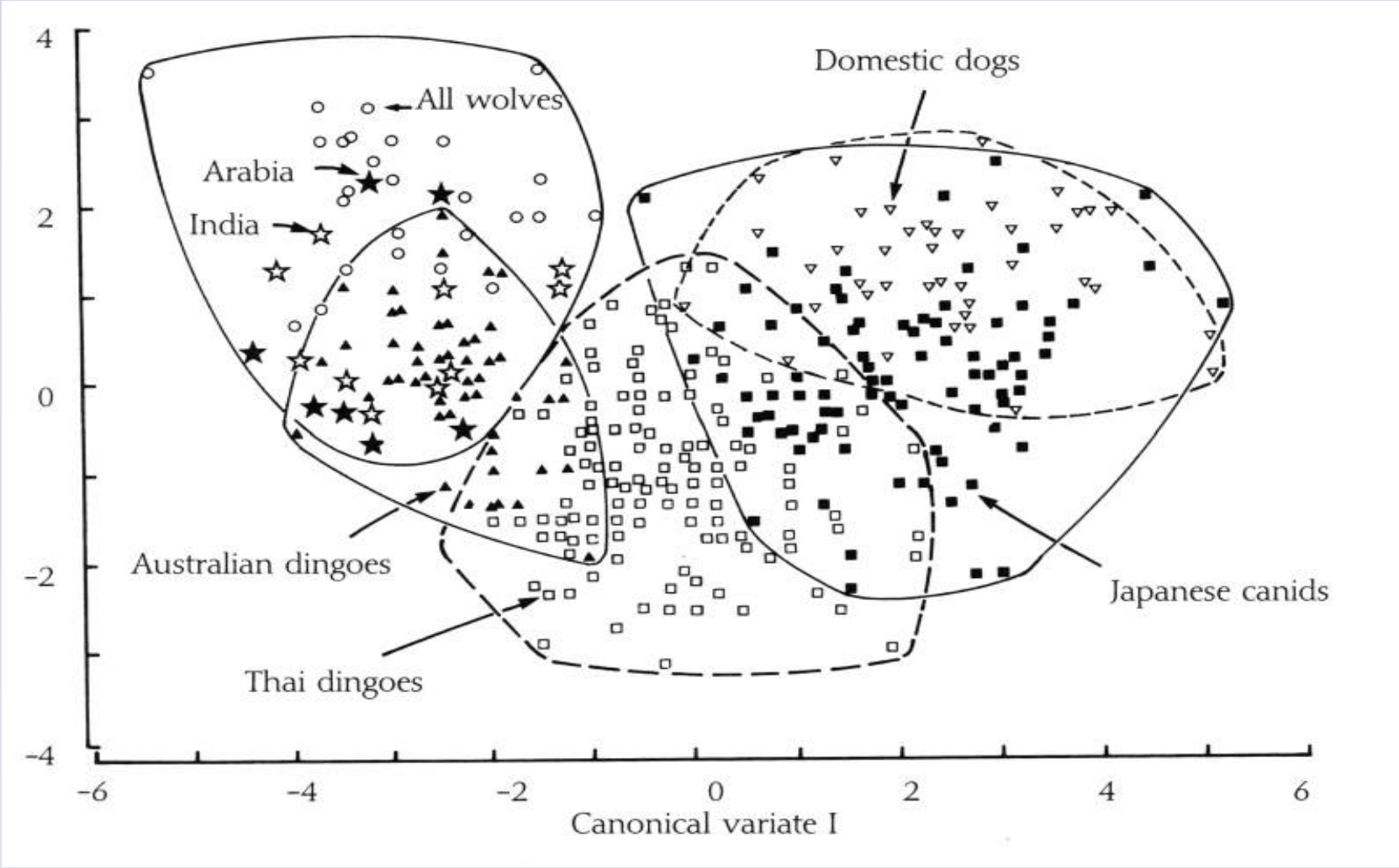


The only reliable method to tell until recently has been skull measurements. Problem with this method – **the animal has to be dead!**



## DINGO / DOG DIFFERENCES

	DINGO	DOG
Coat colour	Ginger, black, tan, yellow	Spotted, sable, etc.
Oestrous cycle	1 per year	2 per year
Communication	Howl	Bark
Skull measurements	longer, narrower snout	Differ in principle components of 8 measures



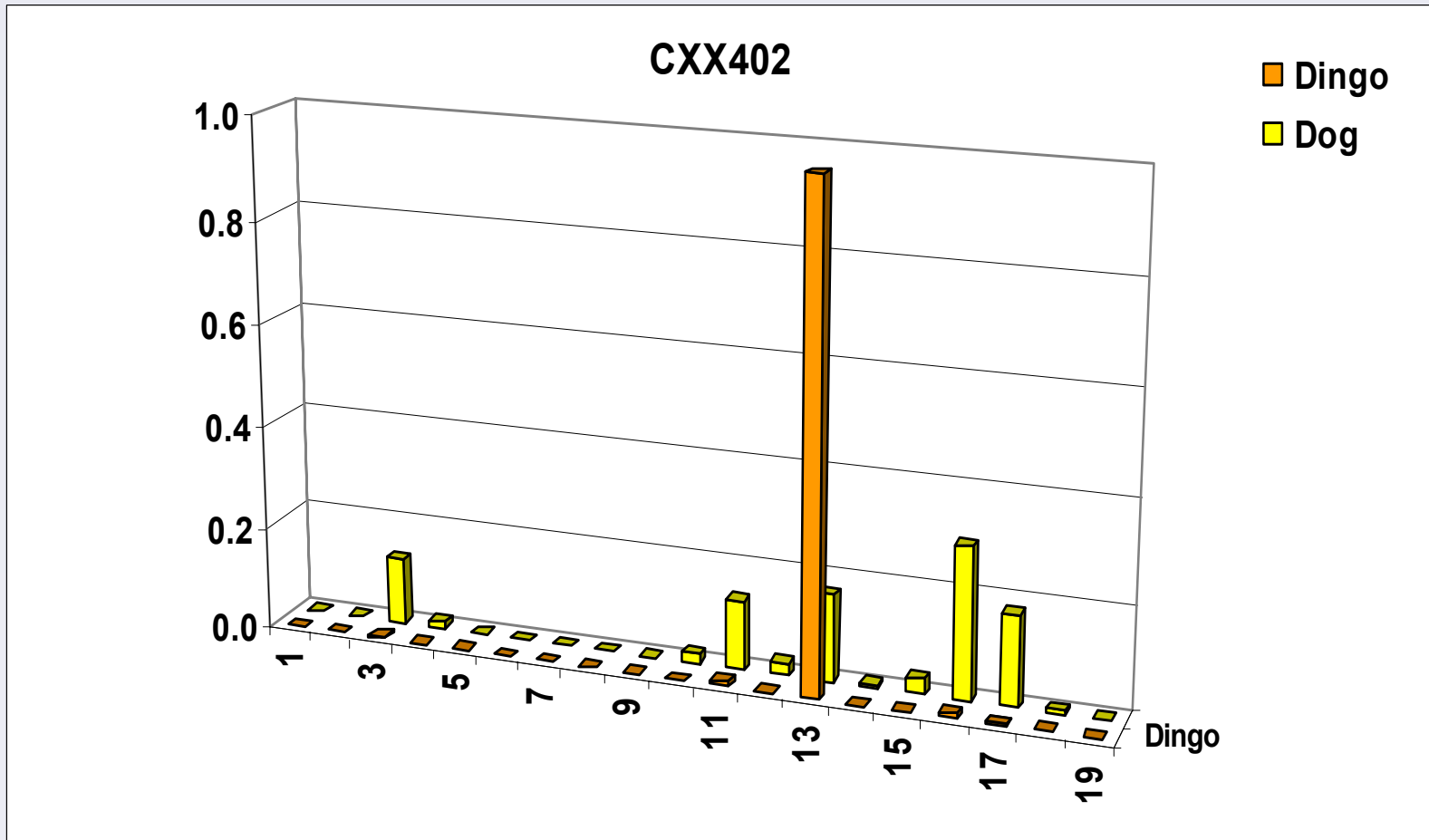
Morphological comparisons of Canids based on 8 measurements of the skull (From Corbett, The Dingo in Australia and Asia, 1995)

## IS THERE A LESS INVASIVE WAY TO DISTINGUISH DINGOES FROM HYBRIDS?

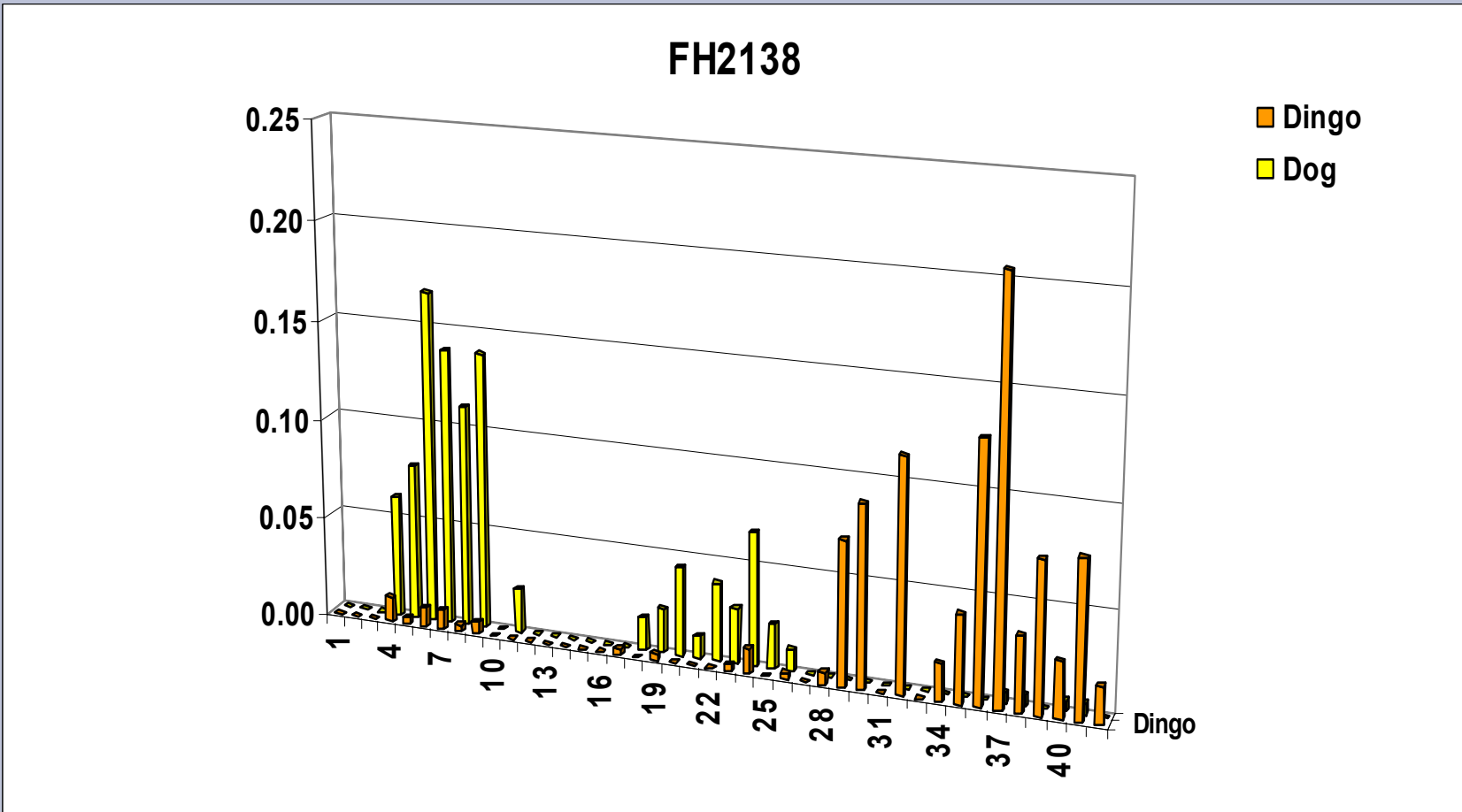
Yes! By genotyping of individuals for dog microsatellites. Hundreds of dog microsatellites were tested. And based on the difference in allele frequency between dingoes and dogs, 20 dog microsatellites were chosen for testing.

These 20 microsatellites have been tested on 3 groups; dingo reference group (n=37), dog reference group (n=68), and a hybrid reference group.

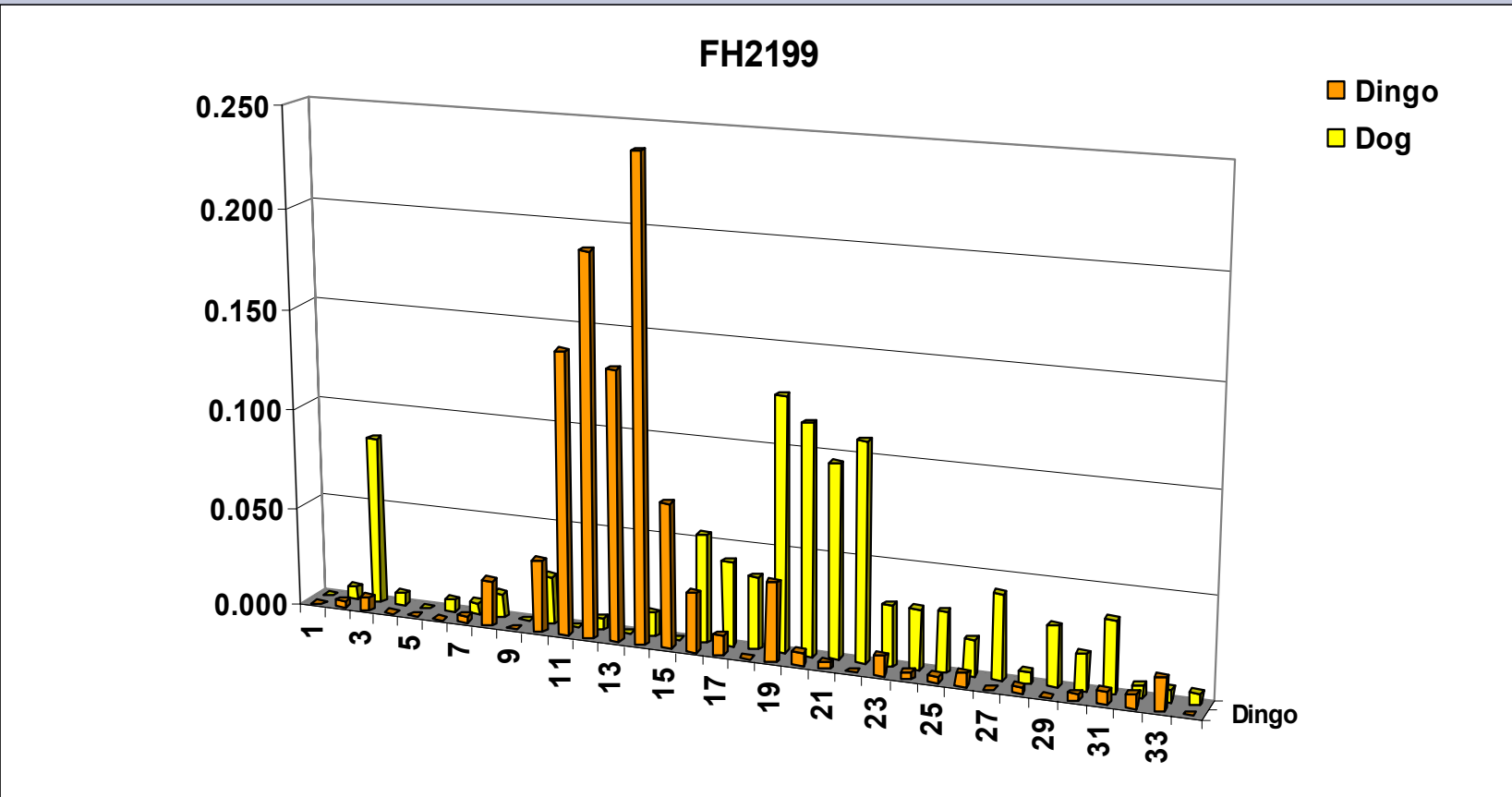
Typical samples for DNA extraction are; blood, tissue (ear punches), skin, and buccal swabs. Over 2000 samples have been collected.



Example of a microsatellite with little overlap between dingo and dog allele sizes and limited variation in dingoes



FH2138 also shows little overlap in allele size between dingo and dog

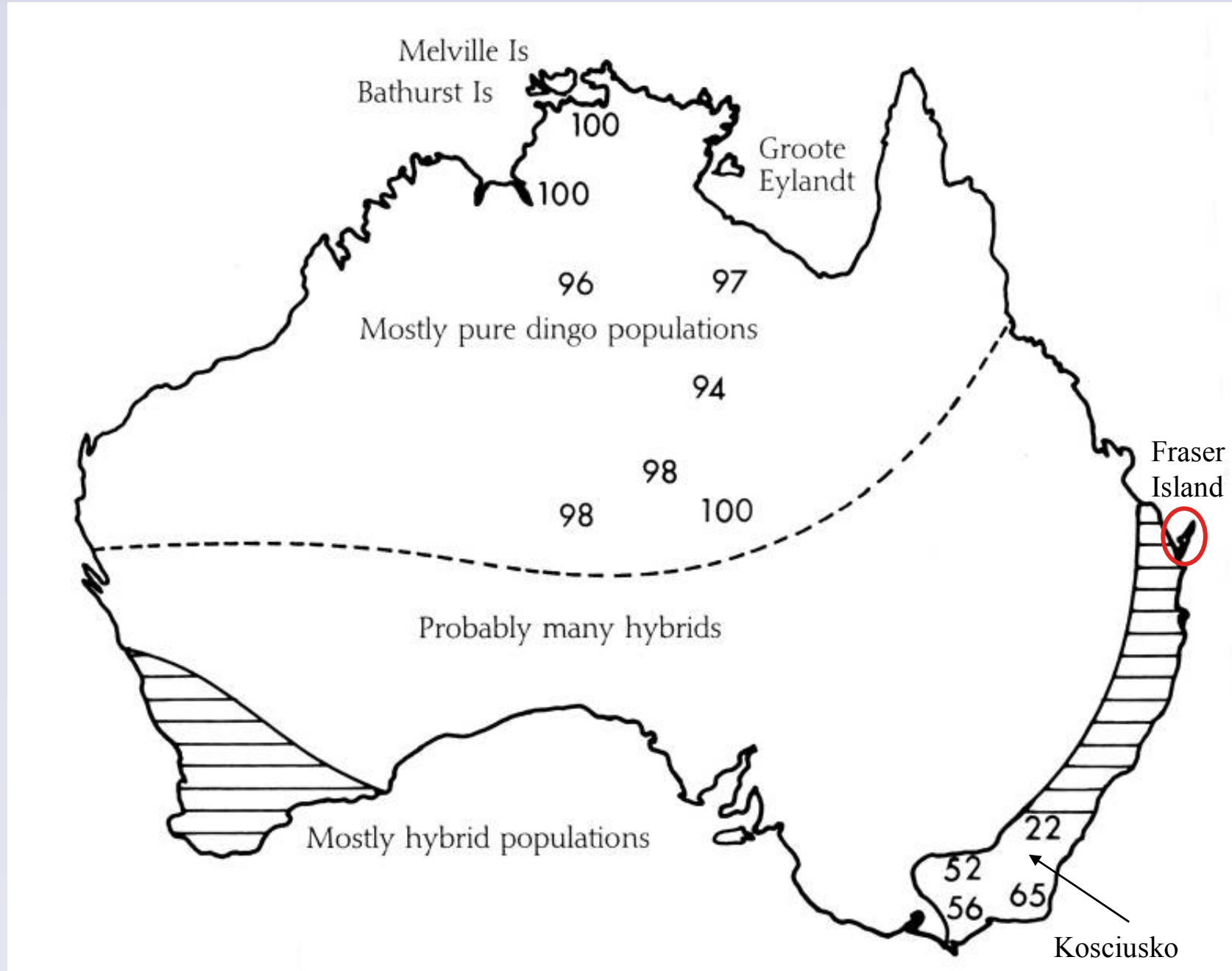


FH2199 has some overlap in alleles between dingoes and dogs

Microsatellites chosen show different distributions of alleles in the groups with an overlap in allele size for some of the loci. The level of variation is much less in the dingo than in domestic dogs.

Markers with little or no overlap in allele distribution are the most useful markers in identifying hybrids. It is obvious if a dog allele appears in a wild canid. Markers like FH2199 that shows overlap can also be used in determining an animal's origin. Is it dingo, dog or hybrid?

Even if some of the alleles appear in both dingoes and dogs, they can still be used to detect hybrids. The probability of finding several of these uncommon types in the dingo is very small and the frequencies can be used to calculate the likelihood of appearance.



Percent of pure dingoes based on skull measurements in 1970s (From Corbett, The Dingo in Australia and Asia, 1995)

## PROBABILITY CALCULATIONS

Using the frequencies of the alleles in the 2 groups – dingoes and dogs – as an estimate of the occurrence in the general purebred populations, and in populations of various hybrids (e.g. 50% dog or 25% dog), relative probabilities in the form of LOD scores are calculated for each sample.

LOD score = log of odds =  $\log(P_{\text{dingo}}/P_{\text{dog}})$ .

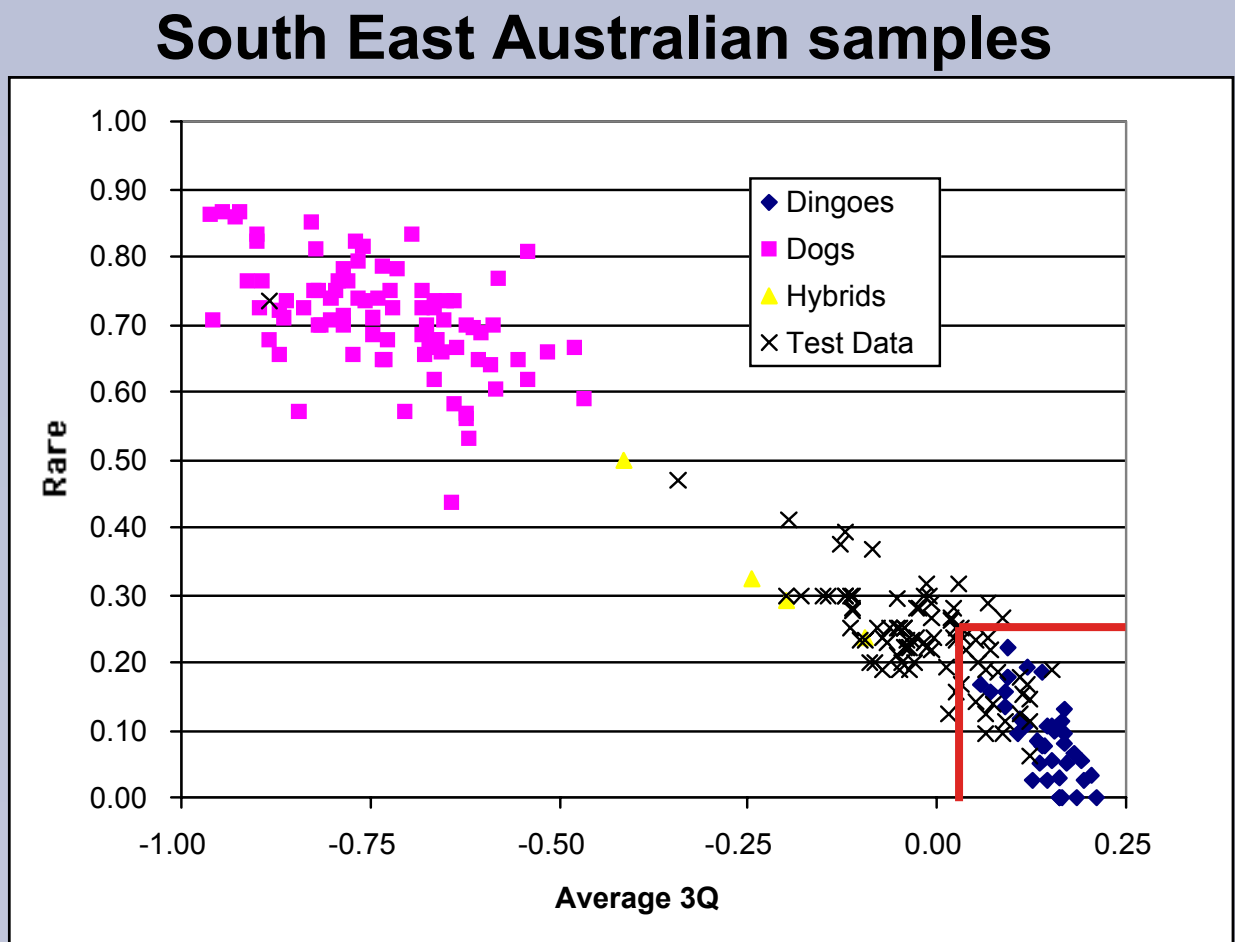
CXX402	dingo	dog	dingo	dog	hybrid (1/2 dingo)	3/4 dingo
140	0	18	0.32%	17.65%	8.82%	4.41%
158	1	1	0.65%	0.98%	0.81%	0.73%
164	4	8	2.60%	7.84%	5.22%	3.91%
168	0	2	0.32%	1.96%	0.98%	0.49%
170	149	18	96.75%	17.65%	57.20%	76.98%
174	0	7	0.32%	6.86%	3.43%	1.72%
176	0	21	0.32%	20.59%	10.29%	5.15%
178	0	27	0.32%	26.47%	13.24%	6.62%
	154	102				

Distribution of alleles in dingoes and dogs for CXX402 with the Probabilities of finding each allele in a dingo, dog or hybrid.

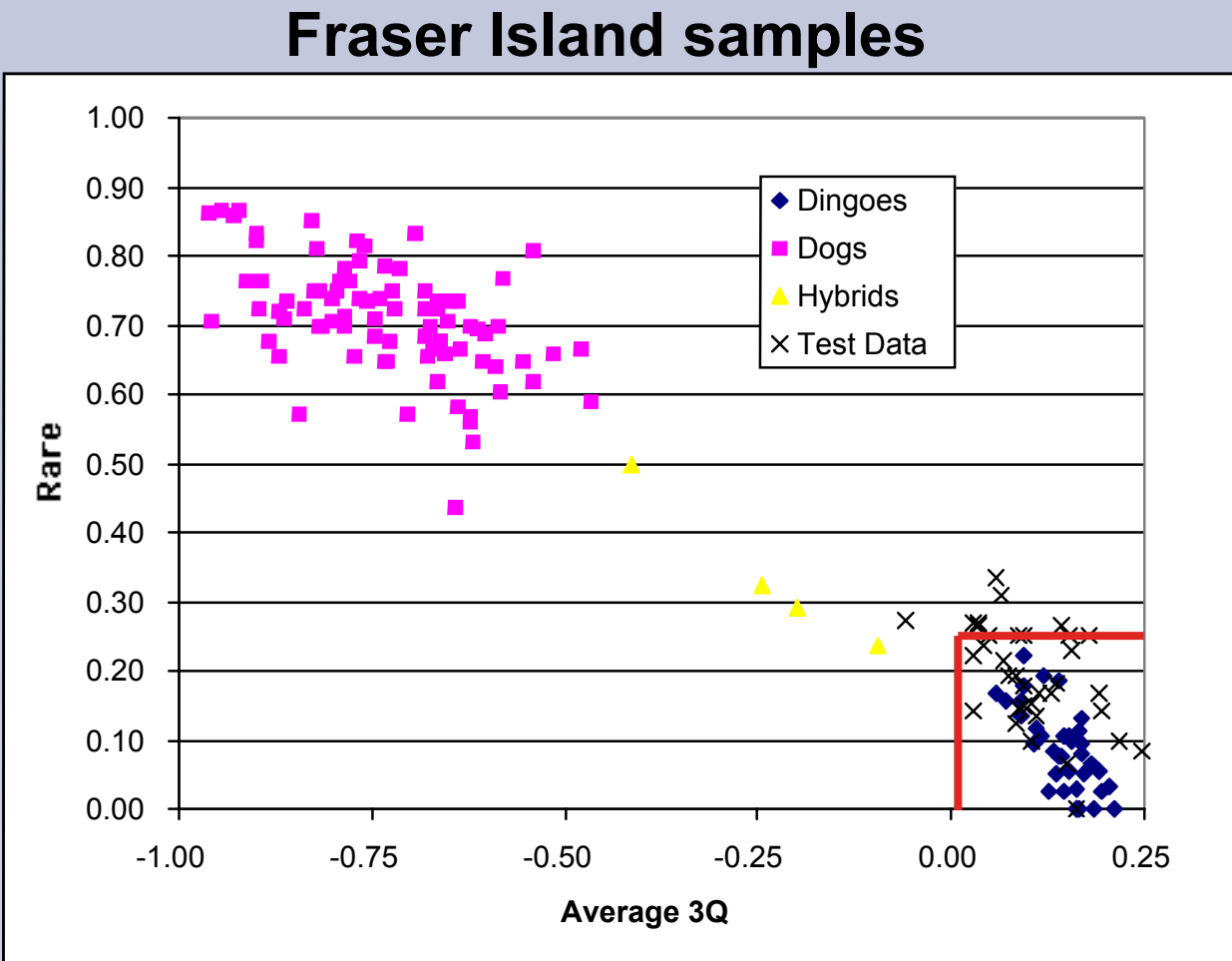
Combining scores for all loci and taking lods gives an estimate of the relative probabilities of a sample originating from one population or another. Since the major interest is in pure dingoes we have chosen to compare the prob of dingo to prob of 3/4 dingo. All loci are not successfully typed, to compensate we have taken the average over all loci, 3Q.

Two measures of purity on wild dog samples (x) from Kosciusko National Park compared to reference dingoes (blue) and dogs (pink)

Red lines contain wild dogs of high purity. Most samples show large degree of hybridisation as in most other areas.



Rare is the proportion of genetic types rarely found in dingoes in the 20 tests  
Average 3Q is average lod score from comparing genetic typing to expectations for dingo and 3/4 dingo



## ARE THE DINGOES ON FRASER ISLAND PURE?

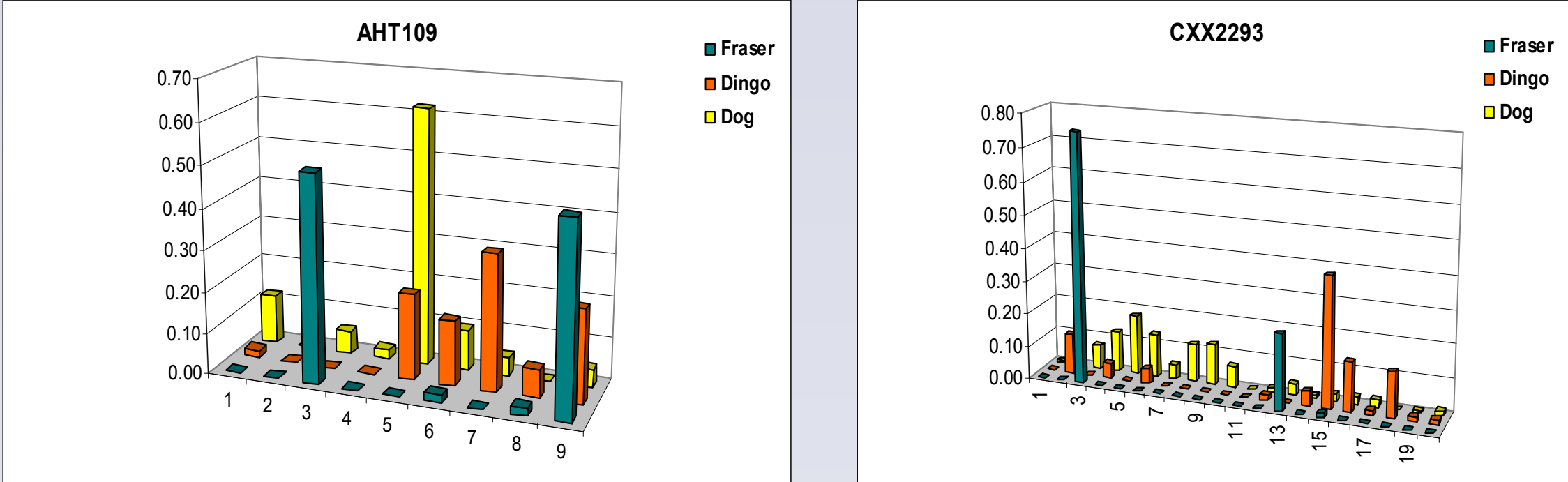
The results suggest that the dingoes on Fraser Island are the purest in densely populated eastern Australia.

However, the Fraser Island population have alleles at two markers that do not occur in the dingo reference population.

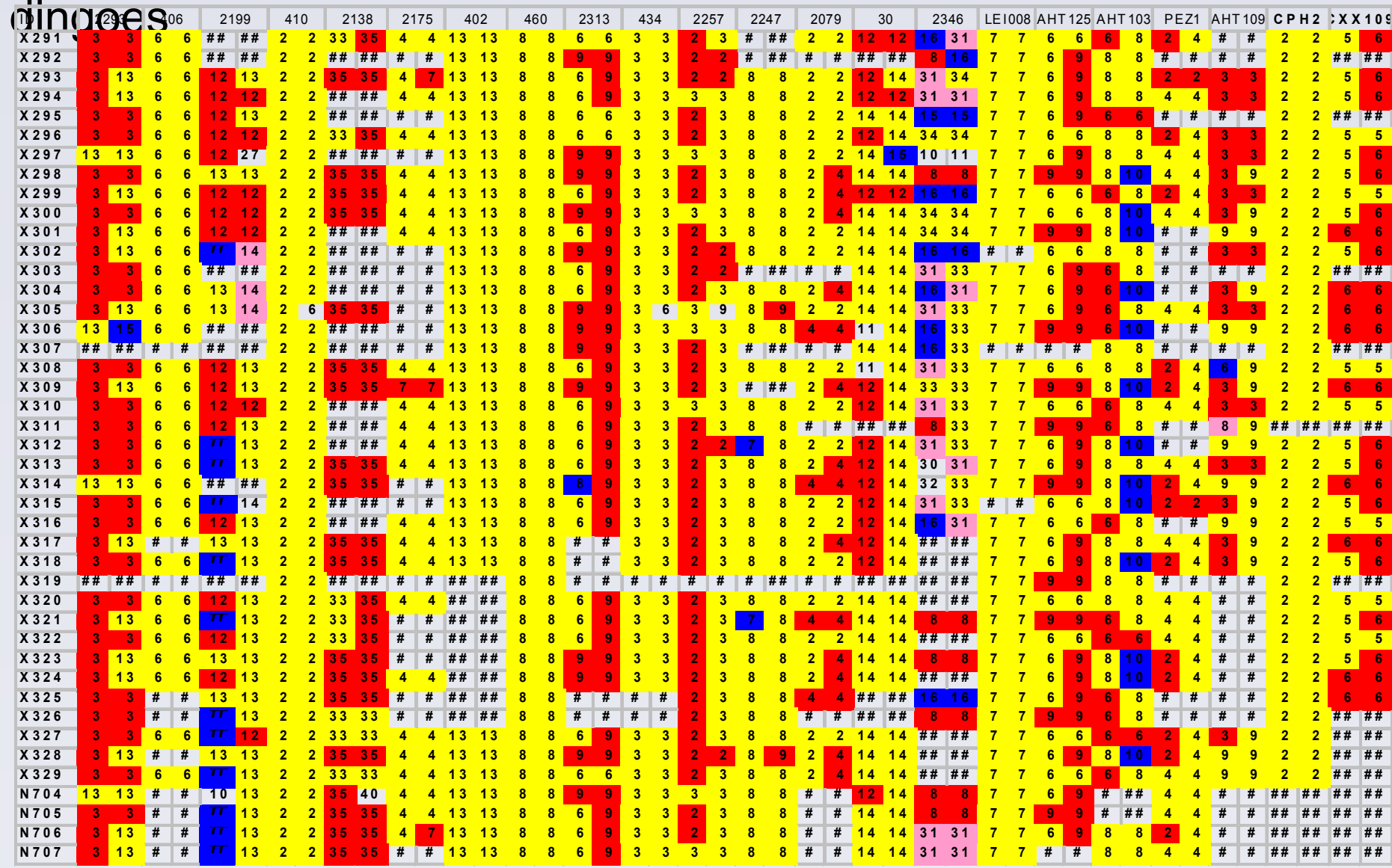
Is this just a regional variation due to isolation of the population, or has introgression of dog genes occurred in the distant past?

The Fraser Island dingoes show very limited variability. This suggests a strong bottleneck in the past. If introgression of dog genes occurred it could not have been a recent event or the population would not be so homogeneous. This raises several questions: Is there regional variation in dingoes?

Are the reference dingoes representative?



Microsatellite alleles found in Fraser Island but not common in the reference dingoes



Genotypes of individual animals from the Fraser Island with alleles colour coded to illustrate limited variability

## DISCUSSION AND FUTURE RESEARCH

This simple approach can be used to detect hybrids because of the large differences in allele frequencies at loci tested. Other analyses now available such as the program Structure should give better estimates of level of hybridisation of individual samples.

Not all hybrids can be detected. Chance and segregation mean that the more loci tested, the more chance of detecting dog ancestry.

Fraser Island may be one of the few areas where there is not a large amount of dog introgression but the 100 animals there are under threat. Recent attacks by dingoes may result in eradication of one of the last remaining pure dingo populations.

The dingo reference group is mainly captive dingoes with a history of breeding pure dingoes. Any samples from the wild are unreliable and are more likely to be hybrids. Testing of DNA from skulls tested in previous studies would make a good test of the methods and the reference dingoes.

Development of methods of typing non-invasive samples, eg scats and hair, would allow tracking of animals in behaviour and conservation studies, as well as surveys of populations for purity.

The outlook for the dingo looks grim with its continued existence relying on a few dingo conservation groups