



## MINIATURE SCHNAUZER BREED: HEALTH & AVIAN TUBERCULOSIS (MAC) AMSC @ MONTGOMERY DOG SHOW 2016


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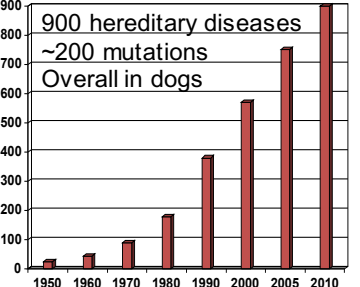
**PennGen**



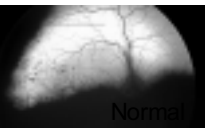
## HEREDITARY DISEASES IN MINIATURE SCHNAUZERS




- Progressive retinal atrophy
- Sick sinus syndrome
- Oxalate urinary calculi
- Myotonia congenita
- Mucopolysaccharidosis VI
- Stomatocytosis
- Hyperlipidemia
- Pancreatitis
- Hepatic AV fistula & others



900 hereditary diseases  
~200 mutations  
Overall in dogs

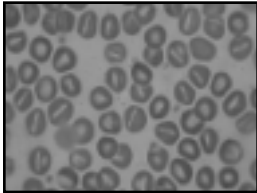
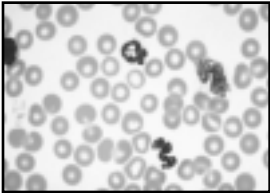


Normal




PRA

## STOMATOCYTOSIS IN MINIATURE SCHNAUZERS




Normal blood smear      Stomatocytosis

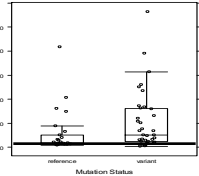
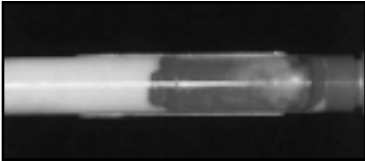


Abnormal blood cell counts – large red cells  
No clinical illness

## HYPERLIPIDEMIA IN MINIATURE SCHNAUZERS




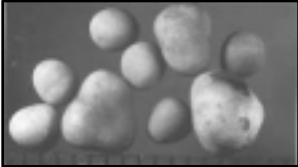



White plasma instead of clear; predisposes to pancreatitis



Eva Furrow

## CALCIUM OXALATE CALCULI IN MINIATURE SCHNAUZERS

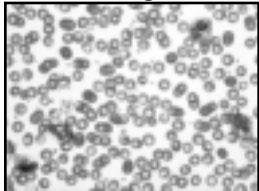
- Common
- Also others bichon Frise, Shih Tzu



Eva Furrow

## MUCOPOLYSACCHARIDOSIS — MPS VI IN MINIATURE SCHNAUZERS

- *Rare in Miniature Schnauzers*
- *DNA test available*
- *Skeletal deformities*
- *Ocular lesions*
- *Liver enlargement*
- *Neurologic disturbances*

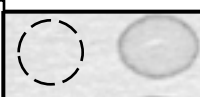


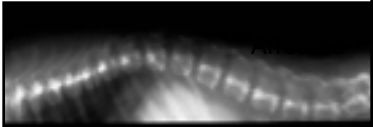

White blood cell inclusions

**Urine Test**

**MPS VI**

Normal Patient


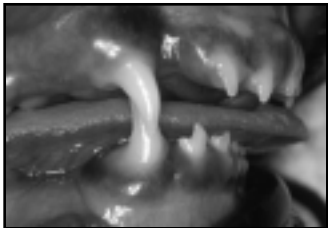


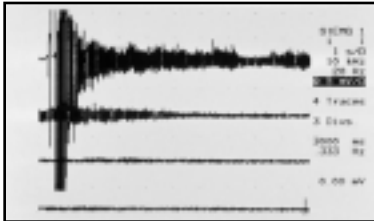



Normal

## MINIATURE SCHNAUZER PUPPIES — MYOTONIA CONGENITA

- Muscle hypertrophy
- Bunny hopping, dimpling
- Chloride channel-1 mutation







CIC-1 gene

Normal allele: ... CTG <sup>268</sup> ACG GTG ...  
Threonine

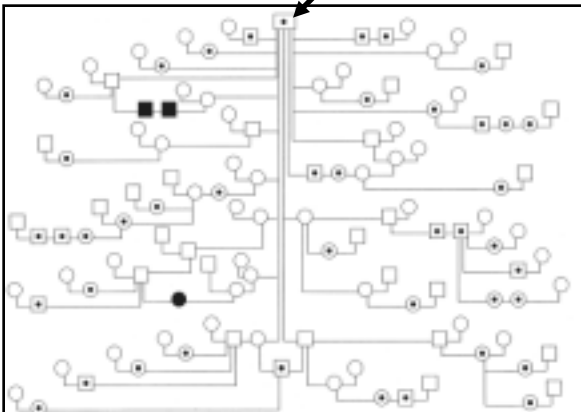

Mutant allele: ... CTG <sup>268</sup> ATG GTG ...  
Methionine



## MYOTONIA CONGENITA IN MINIATURE SCHNAUZERS

>3000 dogs worldwide screened by DNA test since 2000  
18% carriers, all related to one known **common ancestor**


→ **today very rare**


## WSAVA HEREDITARY DISEASE COMMITTEE


*World Small Animal Veterinary Association*  
Assisting clinicians with diagnosis, treatment and control of hereditary diseases and genetic predispositions in dogs and cats.


➤ <http://research.vet.upenn.edu/DNAGeneticsTestingLaboratorySearch/tabid/7620/Default.aspx>



Associate POWERED by










## ***ACKNOWLEDGEMENTS***

- **American Minature Schnauzer Club**
  - Carole Weinberger, president
- **AMSC Health Committee**
  - Patti Henderson
  - Kurt Garmaker
- Initial studies **Errolyn Martin**
- **Numerous pet owners and breeders**
- Veterinary clinicians internationally
  - e.g, Natalia Ignatenko, DVM Kiev
- **Financial Research Support**
  - Gray Lady Foundation
  - AKC Canine Health Foundation
  - National Institutes of Health OD 01939






## ***ACKNOWLEDGEMENTS***

- **Research support**
  - Gray Lady Foundation
  - AKC Canine Health Foundation
  - National Institutes of Health OD 01939
- **PennGen Laboratory**
  - Keijiro Mizukami, DVM PhD
  - Angella Dorsey-Oresto, VMD PhD
  - Anna Eringis
  - Karthik Raj, MS
- **Collaborators**
  - Gary Johnston, DVM PhD Missouri
  - Eva Furrow, VMD, PhD Minneapolis
  - Tosso Leeb, PhD Bern, Switzerland

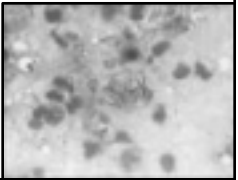




Small Animal Hospital  
~30,000 animals/ year



## Mycobacterium avium Complex (MAC)


- Most mammals are naturally resistant including dogs
- Mostly seen in immunosuppressed people
- Rare reports in the canine literature
- *Mycobacterium avium* is a ubiquitous soil bacterium.
  - Intracellular pathogens - macrophages
- In the past 25 years, systemic avian tuberculosis has been seen in Miniature Schnauzers, suggesting a genetic predisposition to infection.
- Other breed predisposition: Basset hound ~1990
- Young to middle age dogs
- Often undiagnosed or misdiagnosed

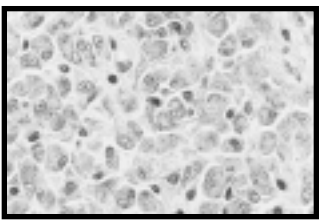




## Mycobacteriosis avium Complex (MAC)

- Lethargy
- Inappetence
- Weakness
- Nasal discharge
- Conjunctivitis
- Diarrhea
- Lymphadenopathy
- Hepatomegaly
- Splenomegaly






- Ddx:
  - Lymphoma
  - Histiocytic sarcoma
  - Systemic infection

Many acid fast staining organisms

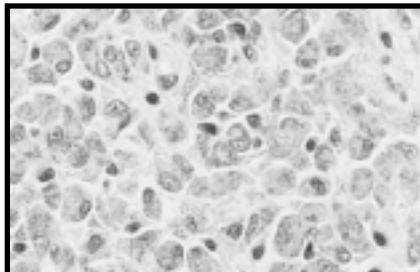
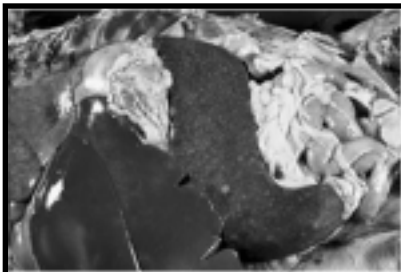
Bacterial culture

PCR species identification

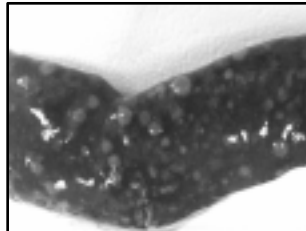
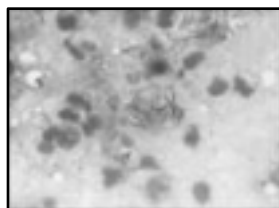
Primary peripheral lymph nodes in the dog



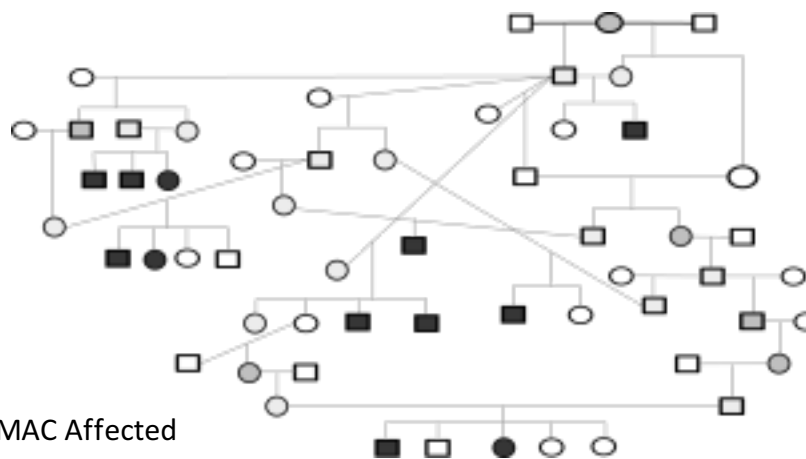
## Mycobacteriosis avium Complex (MAC)



- Lethargy,
- Inappetence
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- Lymphadenopathy
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## MAC IN MINIATURE SCHNAUZERS



■ MAC Affected

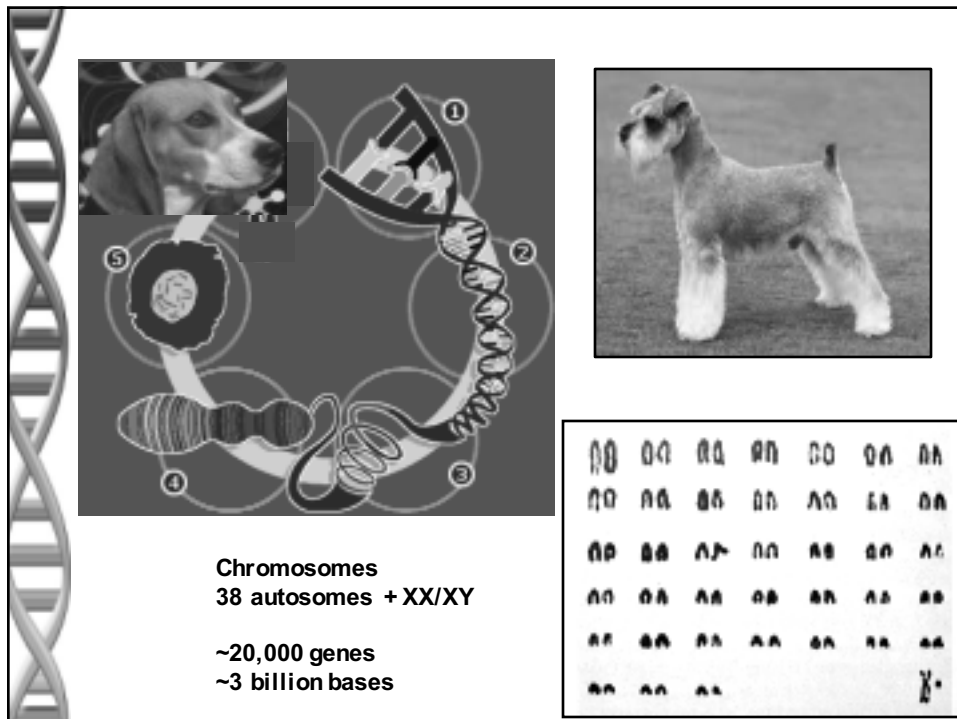
□ Carrier – producer/analysis

◻ Carrier - analysis

No Giant and Middle Schnauzers  
However, also seen in Bassets.

## MAC INVESTIGATIONS IN MINIATURE SCHNAUZERS

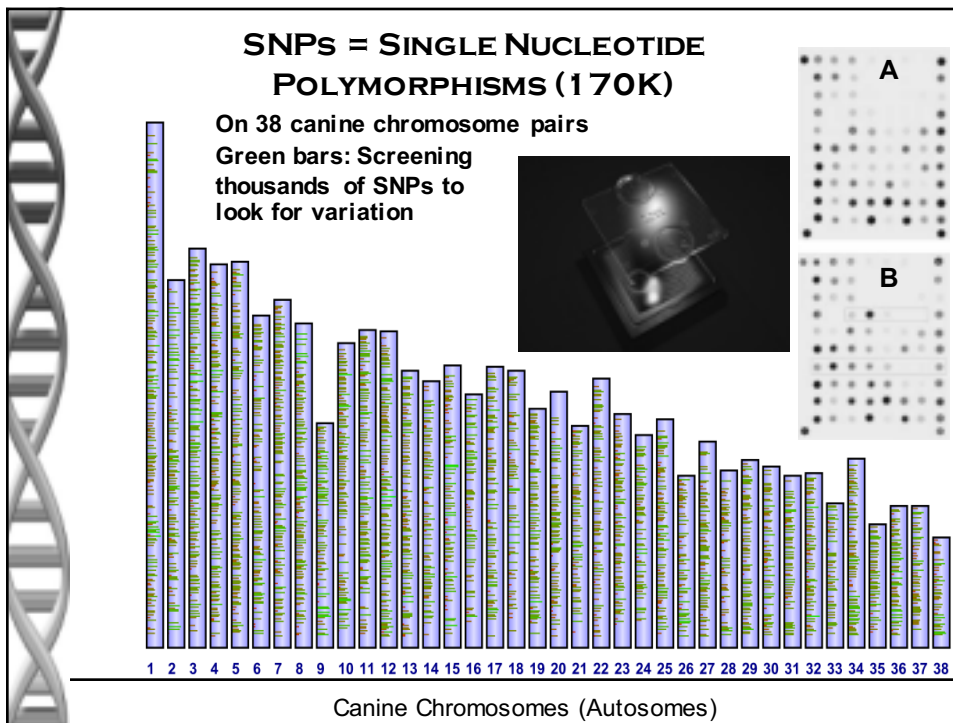
- Collect and select samples and dogs
- Genome wide association study (GWAS)
- Whole genome sequence
  - Affected dogs with MAC
  - Comparison to other Miniature Schnauzers
  - Comparison to other dogs
- Specific search for gene in region
- Identification of Mutation
- Immune dysfunction studies



Chromosomes  
38 autosomes + XX/XY

~20,000 genes  
~3 billion bases

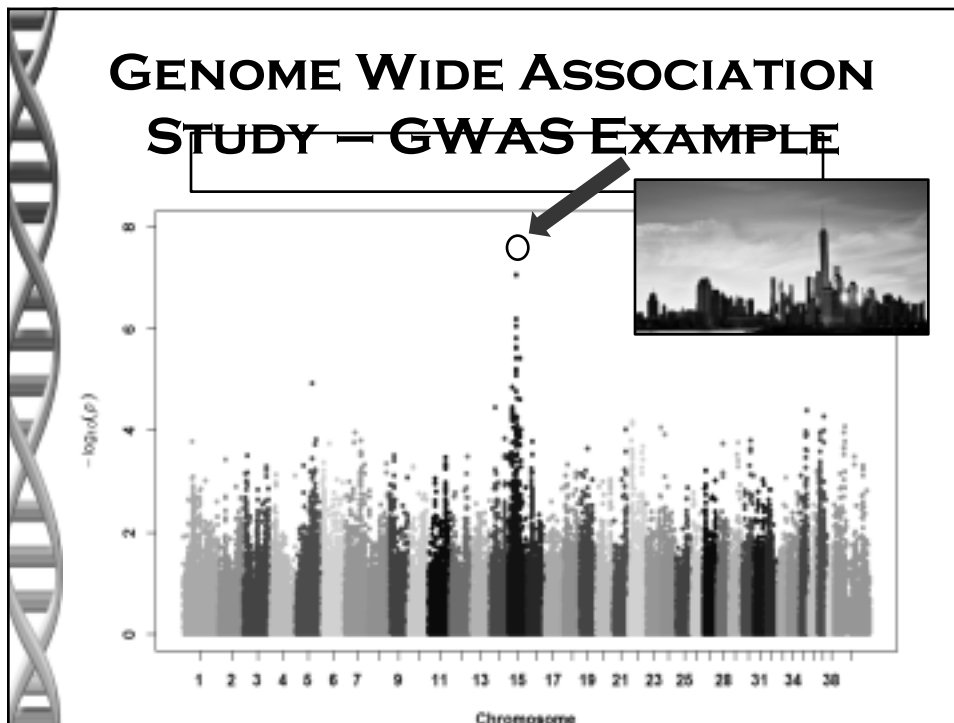




**Polymerase Chain  
Reaction**

**Thermocycler**


**Real time Thermocycler**



### DNA CHANGE IN MAC IMMUNE FUNCTION

- Single Nucleotide Polymorphisms (SNPs)
- Single base changes are called SNPs
- Representing mutation
- Some are variable between breeds and individuals of a breed.
- Functional defect not yet defined.

- EDTA blood
- Cheek swabs
- Semen
- Tissue



A – Adenine      G – Guanine  
C – Cytosine      T – Thymine

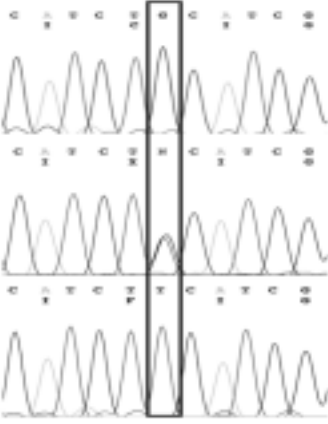
SNP

**CATCTGCATCG**  
**CATCTTCATCG**


Dog 1  
**GG**

Dog 2  
**GT**

Dog 3  
**TT**



## MAC SCREENING



- ❖ >300 Miniature Schnauzers screened
  - ❖ ~8 % are carriers for MAC
- ❖ 223 reported to AMSC Health Committee
  - ❖ 6% or 14 dogs are carriers
- ❖ Common ancestor
  - ❖ All carriers have Jerry O's Future Shock and Bandsman's Newsprint (mother and son) in pedigree
  - ❖ Potential exceptions are being investigated.
- ❖ Small survey thus far.

## MAC SURVEY IN MINIATURE SCHNAUZERS

- ❖ >300 Miniature Schnauzers screened
  - ❖ ~8 % are carriers for MAC
- ❖ 223 reported to AMSC Health Committee
  - ❖ 6% or 14 dogs are carriers and 1 is affected
- ❖ Common ancestor
  - ❖ All carriers have Jerry O's Future Shock and Bandsman's Newsprint (mother and son) in pedigree
  - ❖ Potential exceptions are being investigated.
- ❖ Small survey thus far compared to
  - ❖ Myotonia congenita (>3000 Min schnauzers)
  - ❖ NAD in Papillons (~ 500 nearly same time period)
  - ❖ MPS IIIB in Schipperkes (~3000)

## ACCURACY OF MAC SCREENING

- ❖ DNA mutation tests are most accurate – far better than others
- ❖ MAC DNA testing is precise to detect carriers and affecteds
- ❖ Limitation are related to dog identification and human errors

## AUTOSOMAL RECESSIVE INHERITANCE

**Recessively inherited disorder are spread in the population by heterozygous, clinically asymptomatic/unaffected dogs.**

## BREEDING RECOMMENDATIONS AGAINST MAC

- Breed only DNA tested Min Schnauzers
  - In future dogs can be cleared by tested parents.
- DNA testing does not determine if you can breed or not but with whom.
  - Breed clear to clear or clear to carrier.
- Do not avoid breeding carriers with otherwise great breed characteristics.
  - Test offspring intended for breeding from clear to carrier matings.
- Do not select against/for one disease/trait

## AMERICAN MINIATURE SCHNAUZER CLUB (AMSC) @ MONTGOMERY DOG SHOW 2016 *Urs Giger*

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**PennGen Thank You!**