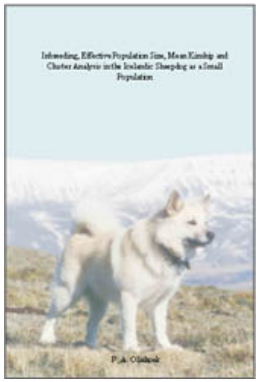
Pieter Oliehoek

WAGENINGEN UNIVERSITY
WAGENINGEN UR



Kormak

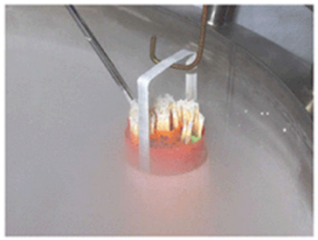
Wageningen University

- Center for Genetic Resources
  - Responsible for Animal Genetic resources (Livestock)

Research:

•In situ

•Ex situ



- Departement of Animal breeding & genetics
  - Responsible for genetic improvement

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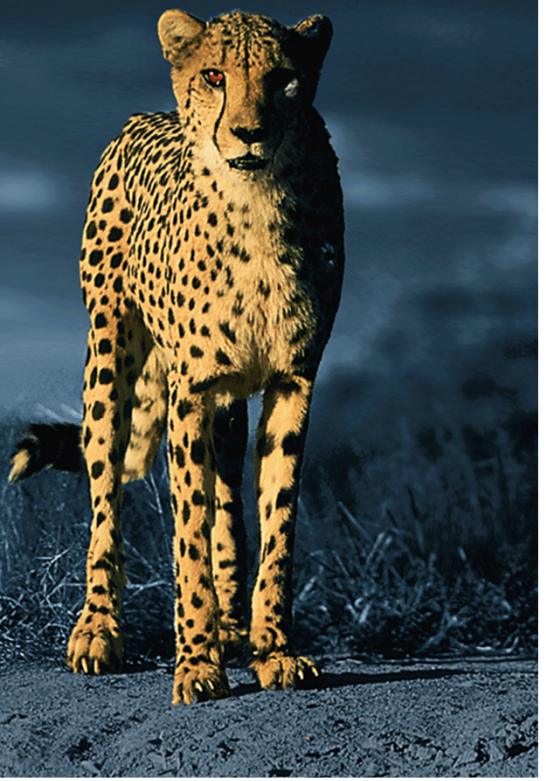
Genetic Conservation of Captive Animal Populations

Pieter Oliehoek

pieter@oliehoek.nl



This talk

- **Conservation of a breed: What do we want?**
  - ?
  - ?
- Some Basics: Kinship (measures)
  - founders
  - genetic diversity
  - effective population size
- Icelandic Sheepdog Population
  - numbers for the Icelandic Sheepdog till 1998..
  - Graphs..
- Breeding
  - cow, chicken vs. dogs
  - selection (not mating)
- Conclusions:
  - no selection on first litter
  - pedigree file in order

What to conserve?

- What do you actually want to save??
  - Take 5 minutes to discuss..

What to conserve?

- Founder (alleles)
  - in other words: the breed that once was..
  - like alleles introduce through the dogs that were selected by Mark Watson
- Adaptive (genetic) potential

What to conserve?

- Performance:
  - Healthy animals
  - Temperament (mentality)
  - Herding abilities
  - Appearance
- Adaptive (genetic) potential

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Measures..

Scale:	1/x	x	1/2x	1-x	Δx [b]	1/(2Δx)
Inbreeding		$\overline{F}$		H_o [a]	ΔF	N_e
Pairwise kinship		$\overline{f}$			Δf	
Average Mean kinship		$\overline{mk}$	N_{mk}	H_e [a]		
Minimized mean kinship			N_{OC}			
Allelic diversity [a]	AD		N_{AD}			

There are many.. which measure to pick ??

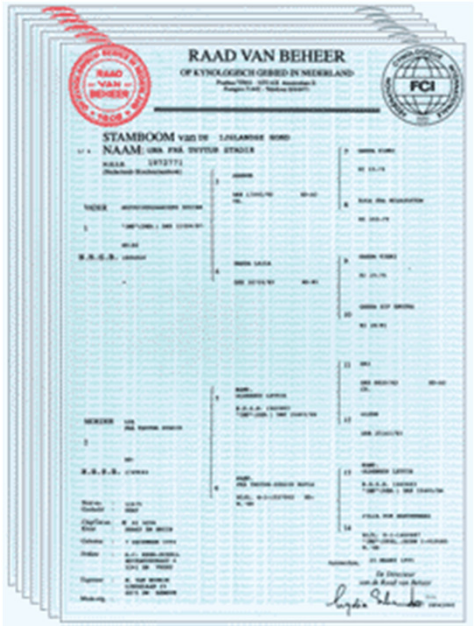
Measures:

- True population Size
  - interesting indicator
- Allelic diversity
  - Founder alleles that still survived till the current population..
  - measured by a 'genedrop' (simply measure the number of alleles)
- Genetic diversity
  - The adaptive potential of a breed !!!!!
- Effective pop. Size
  - because many people work with that

First: genetic diversity

- It preserves the adaptive potential of a population
- It is the 'best answer' to avoid inbreeding

The basics: Kinship



⇒ a measure for resemblance

= Chance that two random alleles are Identical by Descent

→ Kinship coefficients

Kinship

A 

B 

Kinship between A & B

=

Inbreeding coefficient fictive progeny

Kinship-matrix (A-matrix)

Example for animals A, B, C and D:

	A	B	C	D
A	0.5	0.3	0.1	0.2
B	0.3	0.5	0.2	0.2
C	0.1	0.2	0.6	0.1
D	0.2	0.2	0.1	0.7

Mean kinship (mk)

Average kinship of one animal with all other animals including itself:

	A	B	C	D		mk
A	0.6	0.3	0.1	0.2	=>	0.3
B	0.3	0.5	0.2	0.2		
C	0.1	0.2	0.6	0.1		
D	0.2	0.2	0.1	0.7		

Inbreeding (F)

	A	B	C	D		F
A	0.6	0.3	0.1	0.2	=>	0.1
B	0.3	0.5	0.2	0.2		
C	0.1	0.2	0.6	0.1		
D	0.2	0.2	0.1	0.7		

Measured per individual:
is kinship with itself – 0.5

Average Mean Kinship

	A	B	C	D
A	0.6	0.3	0.1	0.2
B	0.3	0.5	0.2	0.2
C	0.1	0.2	0.6	0.1
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Sum of all!! (including itself)

Measures:

- Effective pop. Size = $1 / 2\Delta F$
  - *calculated via Kinship..*
- Genetic diversity = $1 / (2 *$ Average mean kinship)
  - *calculated via Kinship..*
- Allelic diversity = $1 / 2 *$ # Alleles
  - *calculated via genedrop..*

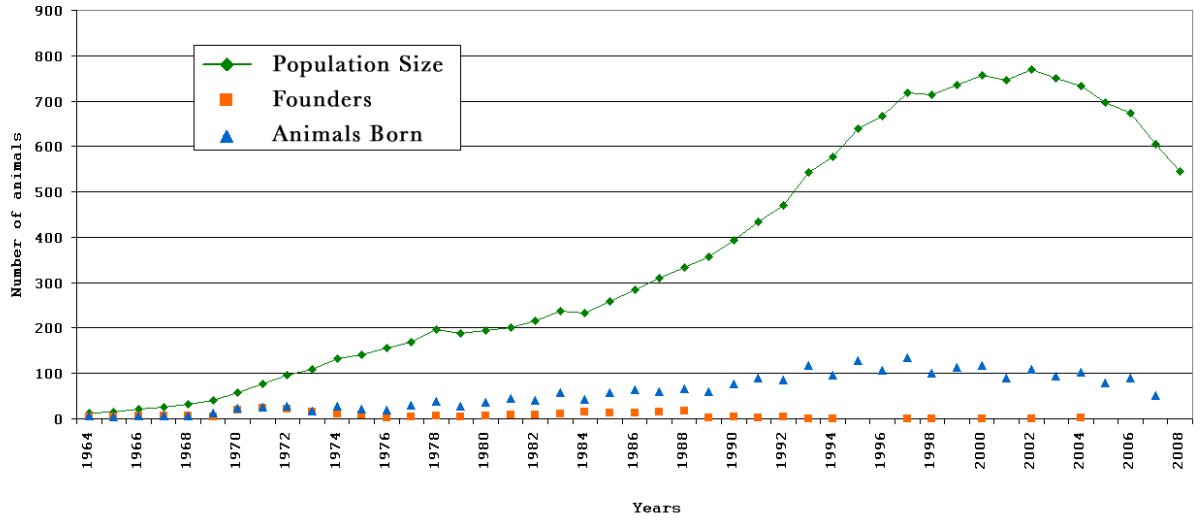
! All numbers are expressed in:
number of animals

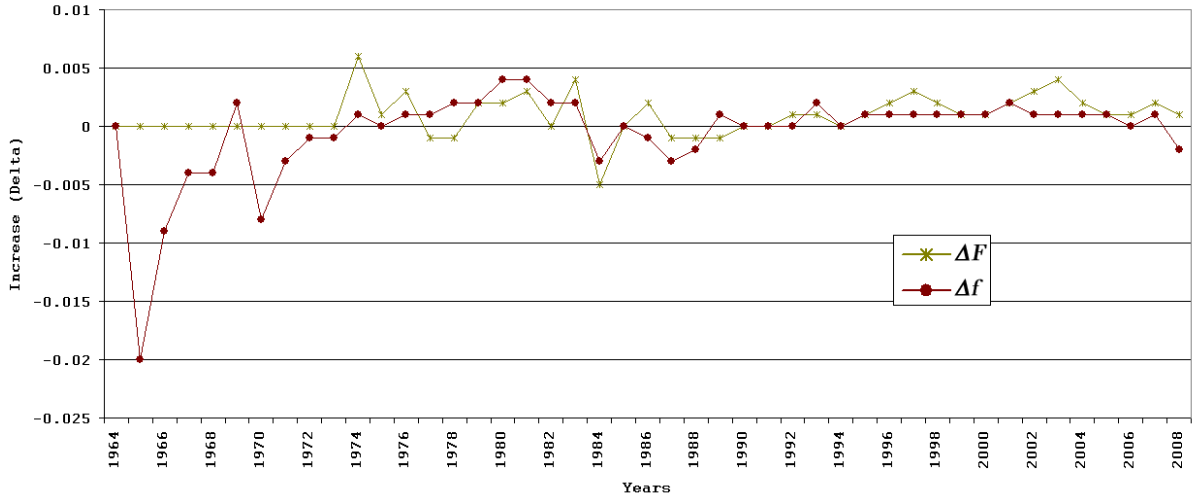
Effective population size & rate of inbreeding

- The theory:
  - With a constant size, large populations establish a balance between selection, mutation and drift.
  - Beware: do not accept any other definition for Effective population size other than
    - $1/2\Delta F$!!!

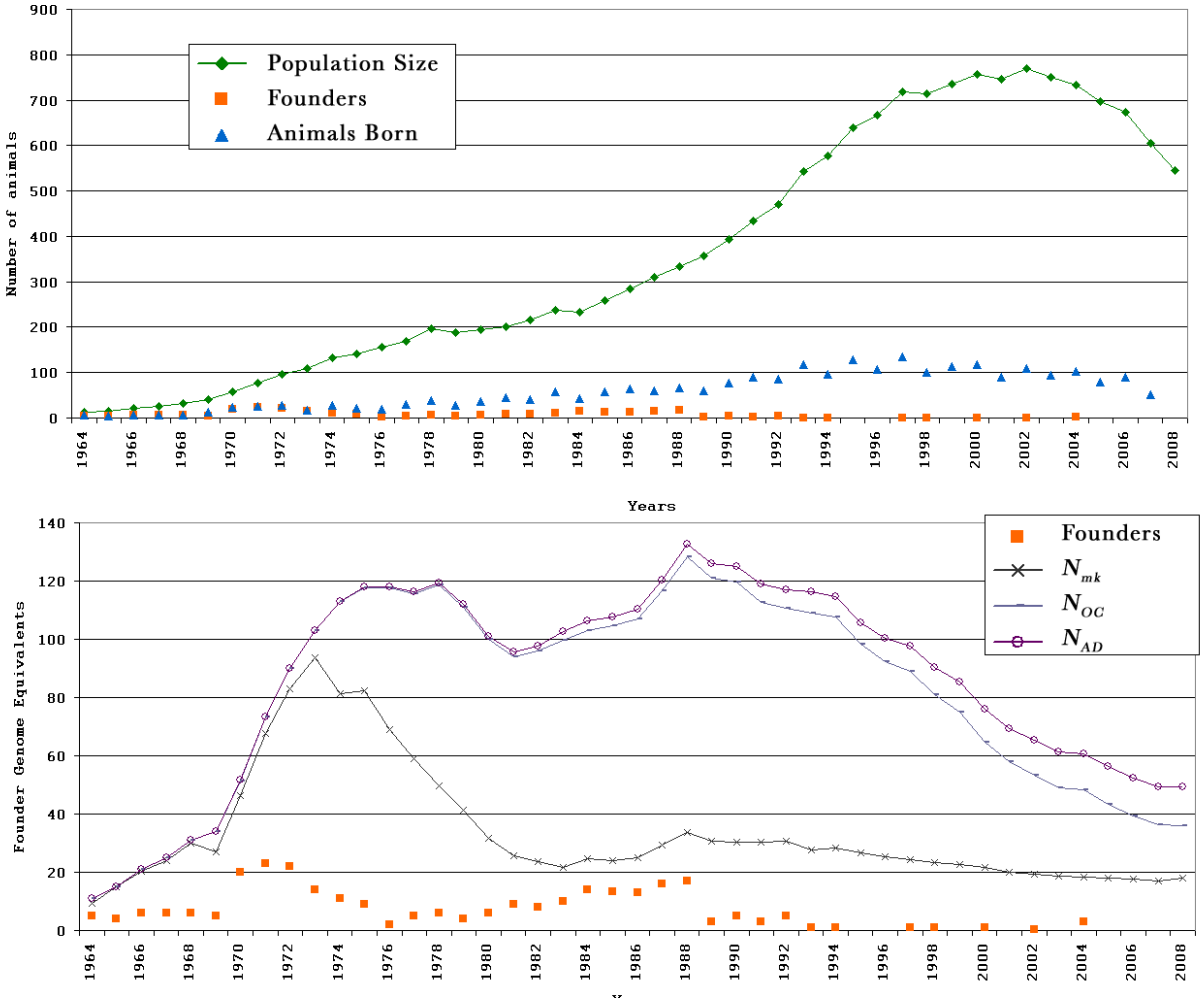
Red Panda (Ailurus Fulgens)

Red Panda – population history





Red Panda - population history



Trend in population

- Population size grew
- Genetic diversity decreased
- Potential diversity was always much higher
- Rate of inbreeding stayed the same

- *Effective Pop. Size (increase of inbreeding)* does not explain what is going to happen..

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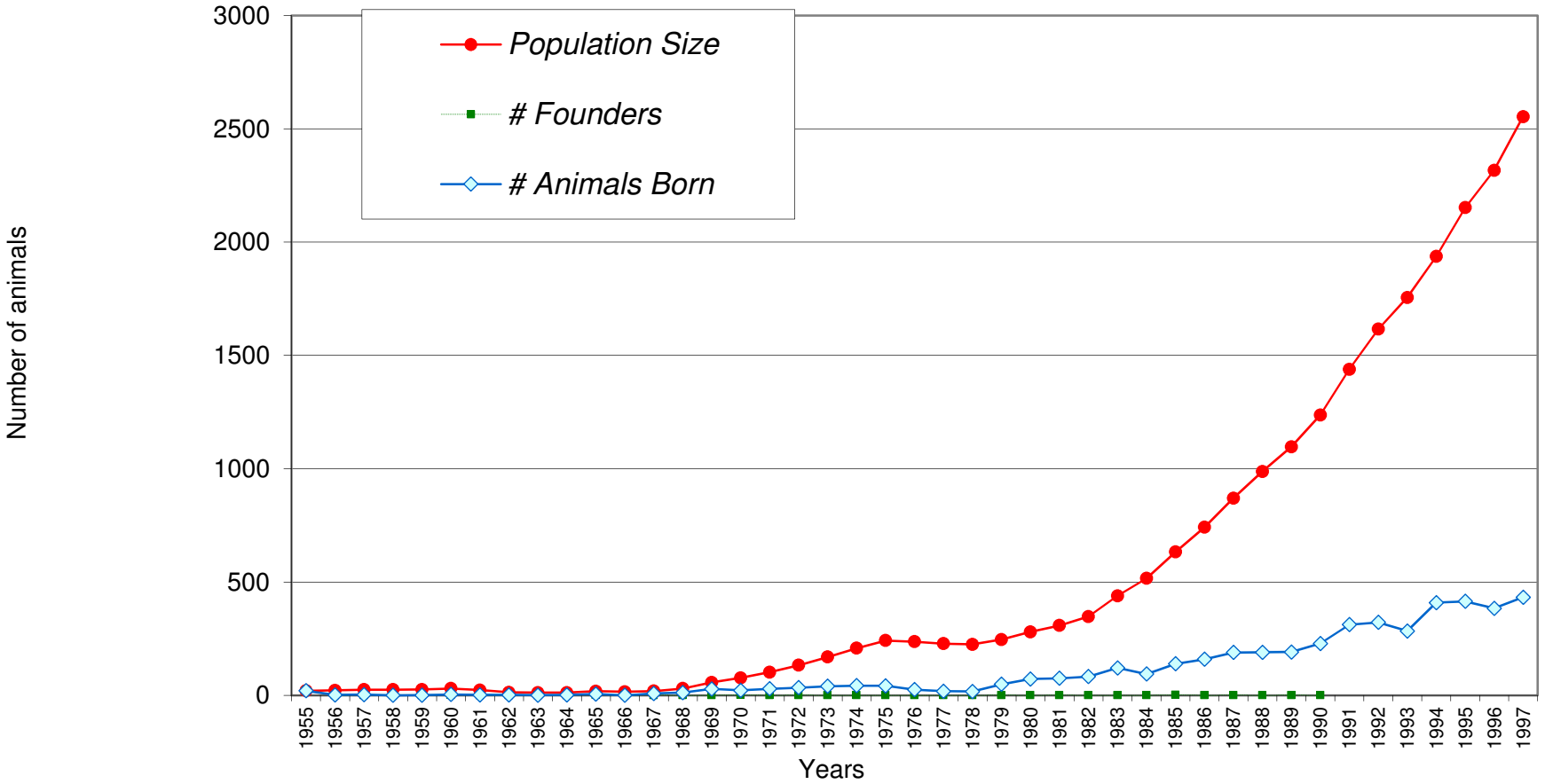
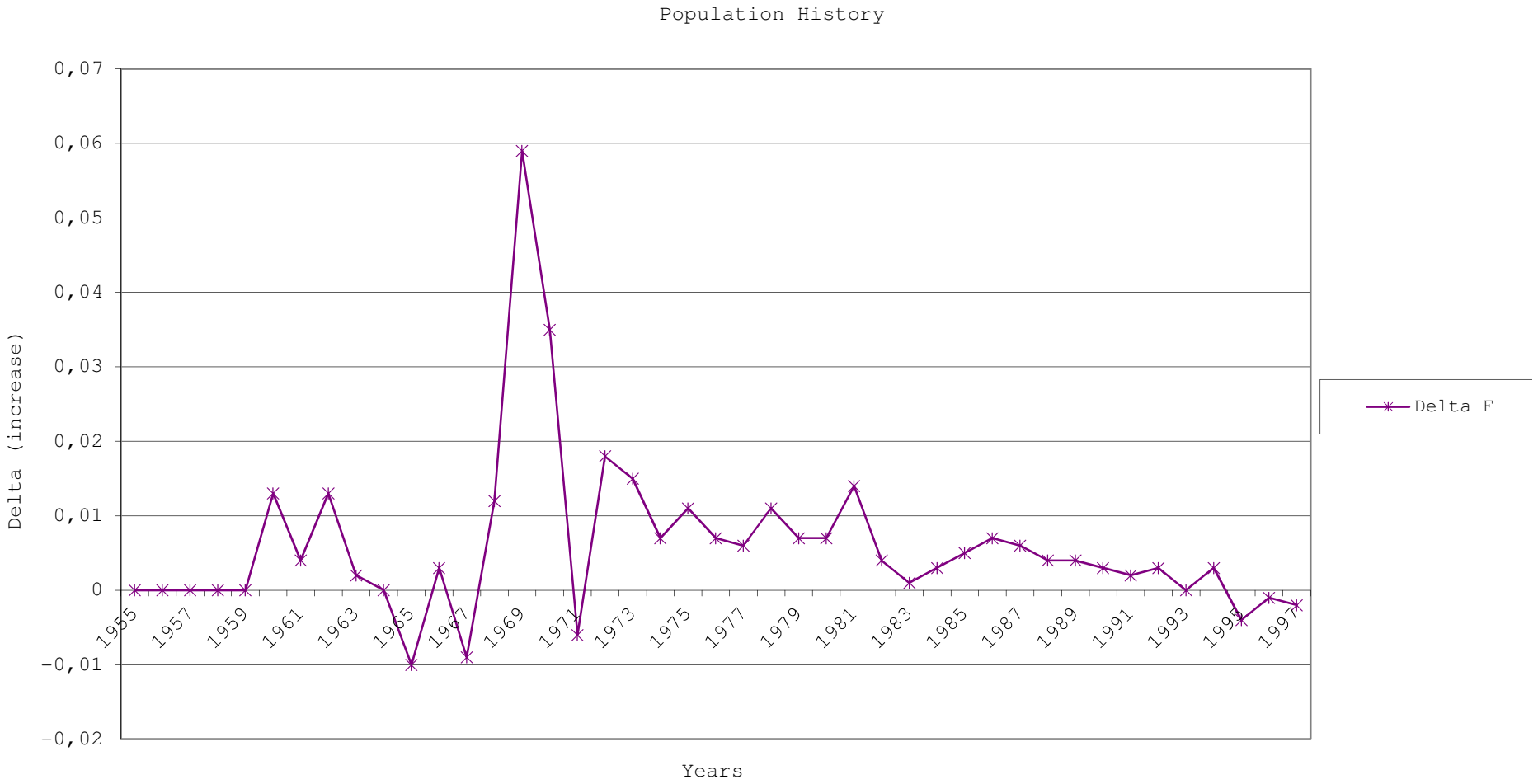
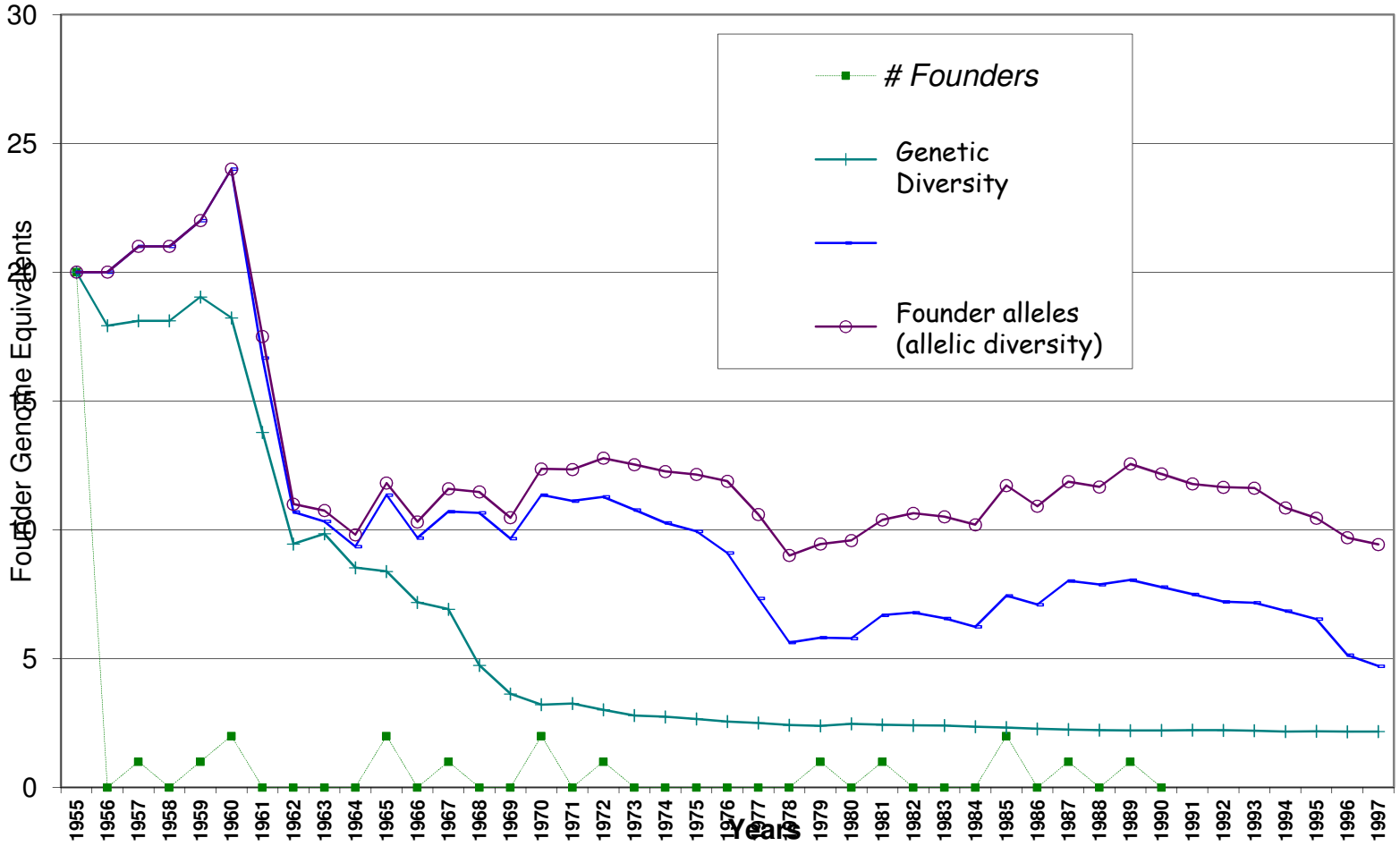
Population Size



Rate of Inbreeding



Founders & Diversity



Gaps in pedigree (intermezzo)

- Hampers conservation
- Hampers breeding goals..

Kinship-matrix (A-matrix)

Example for animals A, B, C and D:

	A	B	C	D	
A	0.5	0	0.1	0.2	
B	0	0.5	0	0	=> mk = 0
C	0.1	0	0.6	0.1	=> F = 0
D	0.2	0	0.1	0.7	

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What happend??

- Only few animals were selected
- Many puppies per individual
- (unequal contribution)

Lets focus into:

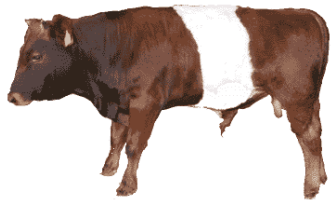
Breeding!

Breeding

- Selection of Animals

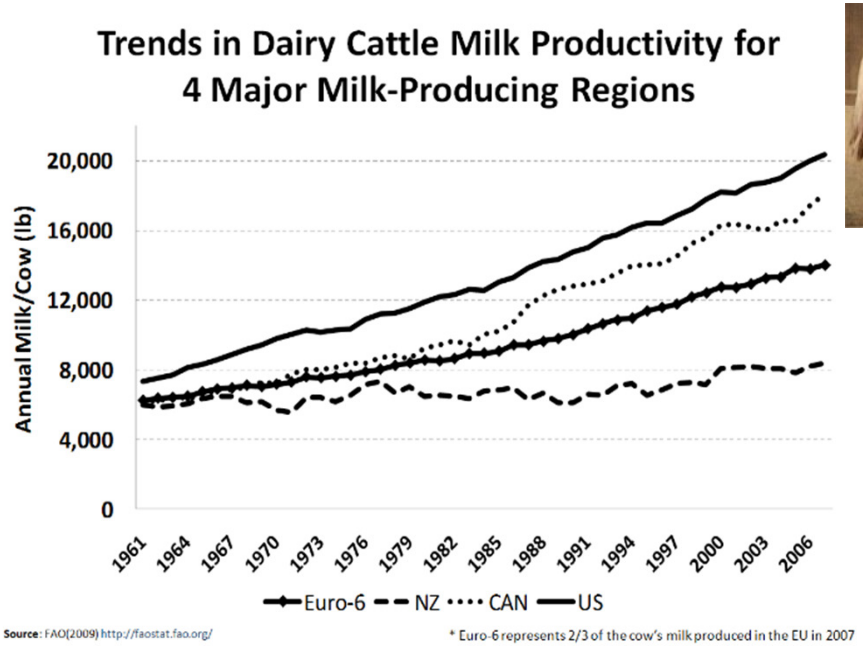
- Mating of Animals

X



Livestock breeding

- Cow-milk production almost tripled



- Poultry-meat production doubled
  - twice the growth
  - in half the time: chick look adult within 8 weeks =>

Livestock breeding

- Many many animals
  - and many test-results per animal: all are screened
- Complete control over the population
  - federation of farmers
  - individual high tech companies producing millions of chicken
- Advances statistics
  - resulting in BLUP-selection methods
  - supported by genomics (DNA-tests)
- Earning millions of money
  - 1 gram of milk extra means thousands of euro's extra

Dog breeding

- low number of animals
  - and many puppies are sold to never be seen again...
- Every breeder makes their own decision
  - some rules are opposed but their effect cannot be measured
  - breeders focus on select a male for their bitch
    - Focus is on mating and not on selection for the next generation...
- No Advances statistics
  - 'mass-selection' is applied but not consistantly
  - HD-tests and Eye-screening-tests are not highly reliable
- Effort in breeding is in spare time
  - But some breeders are highly motivated

Breeding in detail

- Heritablities
  - calculated for many traits in cows
  - unknown for dogs (some mentality traits are known)
- Trait trade-off !!
  - Selection of one trait might reduce another
  - Correlation between traits are calculated
- Breeding programm
  - livestock breeding calculates loss of performance

Overall Conclusions

- High number of dogs in de population => Good!!
  - thanks to all the enthausiastic breeders
  - and of course the lovely breed
- Loss of diversity is not visible only by inbreeding-levels
  - effective population size not suitable for small populations
- Loss of founder alleles was tremendous => Bad !!
  - loss might still be ongoing
- Pedigree registery is not 'connected' anymore
  - we cannot calculate if the loss continues
  - it is more difficult to calculate heritabilities in the future
  - **I am starting up a internet programm to overcome this problem**
- Current measures are excluding many dogs
  - a first litter should have no need for testing
  - second litter of the same dog should have personal tests
  - thrird litter should have progeny testing..

- info also on: www.geneticdiversity.net

Thanks

- For inviting me here so I can
  - meet my old friend
  - share my knowledge
  - meet new Icelandic Sheepdog people

And thank you for your attention!

icelanddog@oliehoek.nl

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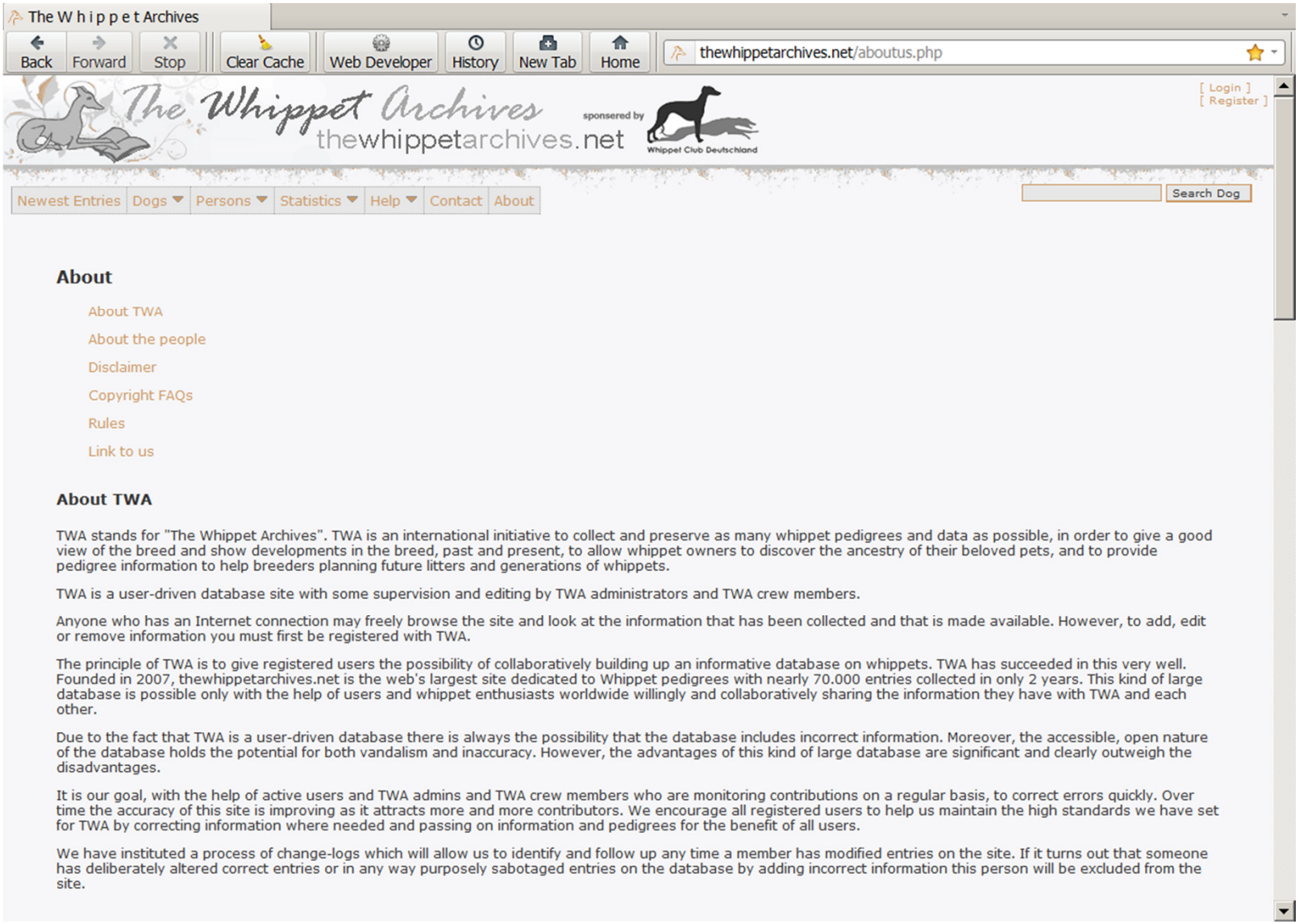
Diseases … (600+)

- Acepromazine sensitivity; Achalasia; Achondrogenesis; Achondroplasia; Achromatopsia type 3; Acinar atrophy; Acne vulgaris; Acral mutilation; Addison's disease; Adrenal hyperplasia; Afibrinogenaemia; Aggressive temperament; Alabama rot; Alexander disease; Alopecia; Alopecia X; Alport syndrome; Amblyopia; Amyloidosis; Anaemia; AnemiaHunter syndrome; Hurler-Scheie syndrome; Hyaluronan accumulation; Hydroxyglutaric acidurea (1-2-HGA); Hydrocephalus and hypertrichosis; Hydronephrosis; Hyperadrenocorticism; Hypercalcemia; Hyperlipidaemia; Hyperlipoproteinaemia; Hyperparathyroidism and renal cortical Hypoplasia; Hyperparathyroidism and renal cortical Hypoplasia (juvenile); Hyperparathyroidism- neoplasia; Hypertonic myopathies; Hypertonic myopathies (Scotty Cramp); Hypertrophic cardiomyopathy; Hypertrophic neuropathy; Hypertrophic osteodystrophy/ hydroxylapetite deposition disease; Hyperuricosuria; Hypoadrenocorticism; Hypochondrodysplasia; Hypochondroplastic dwarfism; Hypofibrinogenemia; Hypofibrinogenaemia; Hypomyelinating neuropathy; Hypomyelination; Hypospadias; Hypothyroidism; Hypothyroidism with hyperlipoproteinaemia; Hypothyroidism with hypomyelination; Ichthyosis; Idiopathic haemorrhagic pericardial effusion; Idiopathic polyneuropathy; Idiopathic thrombocytopenic purpura (ITP); IgA deficiency; IgA deficiency – inflammatory enteropathy; Imerslund-Grasbeck syndrome; Immune mediated thrombocytopenia; Immunodeficiency syndrome; Immunodeficient dwarfism; Immunoproliferative enteropathy; Incomplete ossification of humeral condyle; Infertility; Inflammatory bowel disease; Intradural haemorrhage; Intradural vasculitis; Interdog dominance aggression; Intervertebral disc calcification; Intervertebral disc herniation; Intraocular xanthogranuloma; Intrinsic platelet function defect; Iris cysts; Ivermectin sensitivity; Juvenile polyarteritis; Juvenile myopathy; Juvenile nephropathy; Juvenile onset polyarthritis; Juvenile renal disease; Kartagener's syndrome; Keratoconjunctivitis sicca; Keratinisation defect; Kidney stones; Knee problems; Knobbed acrosome defect; Knock knees; Krabbe disease; Lafora's disease; Laryngeal paralysis; Laryngeal paralysis-polyneuropathy; Leber congenital amaurosis; Legg-Calve Perthe disease; Leishmania susceptibility; Lens luxation; Lentiginosis profusa; Lethal acrodermatitis; Lethal astrocytosis; Leukodystrophy; Leukoencephalo-myelopathy; Leukopenia; Lipid storage disease (Wolman disease); Lissencephaly; Lobster Claw Deformity; Longevity; Lower motor neuron disease; Low Glutathione-S-Transferase; Lumbosacral osteochondrosis; Lung lobe torsion; Lymphocytic thyroiditis; Lymphoedema; Lymphoma; Lymphosarcoma; Malignant histiocytosis; Malignant hyperthermia; Masticatory muscle myositis; Medullary thyroid carcinoma; Megaoesophagus; Meningoencephalitis; Metaphyseal osteopathy; Microphthalmia and anterior segment defects; Microphthalmia with coloboma; Microphthalmia with multiple ocular defects; Mitochondrial encephalomyopathy; Mitochondrial myopathy; Mitral (left atrio-ventricular) valve defects; Mitral (left atrio-ventricular) valve dysplasia; Mitral stenosis; Motor neuron abiotrophy; Mucinosis; Mucopolysaccharidosis I (Hurler-Scheie syndrome); Mucopolysaccharidosis II (Hunter syndrome); Mucopolysaccharidosis IIIa (Sanfilippo syndrome); Mucopolysaccharidosis IIIb (Sanfilippo syndrome); Mucopolysaccharidosis VI (Maroteaux-Lamy syndrome); Mucopolysaccharidosis VII (Sly syndrome); Multicentric lymphoma; Multifocal retinal dysplasia (no skeletal deformities); Multifocal retinal dysplasia with skeletal abnormalities (Oculo-skeletal dysplasia); Multifocal retinopathy; Multiple epiphyseal dysplasia; Multiple ocular defects; Muscular dystrophy; Muscle hypertonicity; Musladin-Leuke Syndrome; Myasthenia gravis; Myoclonus epilepsy; Myopathy; Myopathy and neuropathy; Myopia; Myotonia; Myotonic dystrophy; Myotonic myopathy; Narcolepsy; Nasal dermatitis; Nasal parakeratosis; Necrosis of femoral head (Legg-Calve-Perthe disease); Necrotizing encephalitis; Necrotizing meningoencephalomyelitis; Nemaline rod myopathy; Neonatal encephalopathy with seizures; Neoplasia – glioma; Neoplasia – haemangioma & haemangiosarcoma; Neoplasia - histiocytosis; Neoplasia – mammary carcinoma; Neoplasia – mast cell tumour; Neoplasia – oral melanoma; Neoplasia – osteosarcoma; Neoplasia – soft tissue sarcoma; Neoplasia, various; Nephropathy (juvenile); Nervousness; Neural Tube Defect; Neuroaxonal dystrophy (NAD); Neurodegeneration; Neurogenic muscular atrophy; Neuronal abiotrophy; Neuronal ceroid lipofuscinosis; Neuronal vacuolation; Neutrophil defect; Niemann-Pick disease Type A/B; Niemann-Pick disease Type C; Non-Hodgkin's lymphoma; Nonspherocytic hemolysis; Ocular dermoid cysts; Ocular melanosis; Oculo-skeletal dysplasia, drd1; Oculo-skeletal dysplasia, drd2; Oculo-skeletal-heamatological syndrome; Oligodendroglial dystrophy; Oligodontia; Onychodystrophy; Optic nerve hypoplasia; Osmotic fragility; Osteoarthrosis; Osteochondrodysplasia; Osteochondromatosis; Osteochondrosis dissecans, shoulder; Osteochondrosis dissecans, shoulder & stifle joints; Osteochondrosis of lateral trochlear ridge; Osteogenesis imperfecta; Otitis externa; Overshot jaw; Oxalate nephropathy; Palmoplantar hyperkeratosis; Pancreatic acinar atrophy; Pancreatitis; Panniculitis; Pannus; Paroxysmal dystonic choreoathetosis; Paroxysmal seizures; Patent ductus arteriosus; Patellar luxation; Pectus excavatum; Pectinate ligament dyplasia; Pemphigus foliaceus; Pericardial mesothelioma; Peripheral (femoral) artery occlusive disease; Peripheral neuropathy; Perivasculitis; Persistent hyaloid remnants; Persistent hyperplastic primary vitreous (PHPV); Persistent hyperplastic primary vitreous (PHPV)/Persistent hyperplastica tunica vasculosa lentis (PHTVL); Persistent hyperplastic tunic vasculosa lentis (PHTVL); Persistent Mullerian duct syndrome (PMDS); Persistent pupillary membranes; Persistent right aortic arch; Persistent scratching; Pharmacogenetic abnormalities; Pigmentary glaucoma; Pituitary dependent hyperadrenocorticism; Pituitary dwarfism (combined pituitary hormone deficiency); Platelet mediated bleeding disorder (Scott's syndrome); Platelet storage pool defect (with cyclic neutropenia); Pneumocystis pneumonia; Polioencephalomyelopathy; Polycystic kidney and liver disease; Polycystic kidney disease; Polydactyly; Polydactyly and skeletal and soft tissue abnormalities; Polydactyly and skeletal malformations; Polyglucosan body disease; Polyneuropathy; Polyradiculoneuritis; Portosystemic shunt; Primary familial hyperphosphatasemia; Primary glaucoma; Primary hyperoxaluria type 1; Primary hypertension; Primary open angle glaucoma; Primary orthostatic tremor; Primary sensory neuropathy; Progressive axonopathy; Progressive hereditary nephritis; Progressive paralysis and dementia (Alexander Disease); Progressive Retinal Atrophy; Progressive Retinal Atrophy – early retinal degeneration (erd); Progressive Retinal Atrophy of late onset; Progressive Retinal Atrophy – photoreceptor dysplasia (pd); Progressive Retinal Atrophy- probably as rod-cone dystrophy type 1 (rcd1); Progressive Retinal Atrophy – progressive rod cone degeneration (prcd); Progressive Retinal Atrophy – rod-cone dystrophy type 2 (rcd2); Progressive Retinal Atrophy – rod-cone dystrophy type 3 (rcd3); Progressive Retinal Atrophy – X-linked progressive retinal atrophy; Progressive Retinal Atrophy (retinal pigment epithelium dystrophy); Progressive Rod Cone Degeneration; Protein losing enteropathy (PLE); Protein losing nephropathy (PLN); Pseudoachondroplasia; Psychomotor retardation; Pulmonary fibrosis; Pulmonary hypertension; Pulmonary Oedema; Pulmonic stenosis; Pyoderma (skin infections); Pyruvate kinase deficiency; Quadriplegia; Rage Syndrome; Renal amyloidosis; Renal calculi; Renal cystadenocarcinoma and nodular dermatofibrosis; Renal dysplasia; Renal vasculopathy; Respiratory distress syndrome; Retinal dysplasia; Retinal dysplasia (multifocal, mrd); Retinal dysplasia/degeneration - ceroid lipofuscinosis; Retinal Ganglion cell distribution; Retinal pigment epithelium dystrophy; Rhinitis; Sacral osteochondrosis; Sandhoff disease; Sanfilippo syndrome; Sarcoma; Schisis; Scott's syndrome; Sebaceous adenitis; Sebacious gland hyperplasia; Seborrhoea; See-saw nystagmus; Seizures: malonic acidurea; Selective intestinal cobalamin malabsorption; Sensorial deafness; Sensorineural deafness; Sensory axonopathy; Severe combined immunodeficiency (SCID); Shaking pup; Shar Pei Fever; Sick sinus syndrome; Siezures (partial); Skin and hair abnormalities; Sly syndrome; Sodium thiopentane sensitivity; Solid intraocular xanthogranuloma; Spectrin Deficiency; Spherocytosis; Spina bifida; Spinal cerebellar degeneration; Spinal muscular atrophy; Spondyloarthrosis; Spondylo-epithelial dysplasia; Spondylolithesis; Spontaneous chronic corneal epithelial defects (SCCED); Spontaneous hypertension; Sry –ve sex reversal; Stenosis of the bundle of His; Stiff Skin Syndrome; Stomatocytosis with chondrodysplasia; Stomatocytosis with hypertrophic gastritis; Subacute necrotizing encephalopathy; Subaortic stenosis; Sudden Acquired Retinal Degeneration Syndrome; Sudden death syndrome; Superficial stromal keratitis; Symmetrical Lupoid Onychodystrophy; Syringomelia; Syringohydromelia; Systemic lupus erythematosis; Tail chasing; Tapetal degeneration; Taurine deficiency; Tay-Sachs disease; T-cell non-Hodgkin's lymphoma; Telangiectasia; Tetralogy of Falot; Thiopurine-S-Methyltransferase deficiency; Thrombocytopenia; Thrombopathy; Thrombopathy: delta storage pool defect; Thyroiditis; Tied tongue; Tracheal collapse; Trapped neutrophil syndrome; Tremor syndrome: central axonopathy; Tricuspid (right atrio-ventricular) valve dysplasia; Tubular transport dysfunction "Fanconi's syndrome"; Type 1 von Willebrand disease; Type 2 von Willebrand disease; Type 3 von Willebrand disease; Urate urolithiasis; Urinary incontinence; Uroliths (cystine); Uroliths (struvite, oxalate, other); Uveodermatological syndrome; Vasculitis; Ventricular arrhythmia; Ventricular septal defect; Vitiligo; Vitreous degeneration; Vogt-Koyanagi-Harada syndrome; White matter spongy degeneration; Wobbler syndrome; Xanthinuria; X-linked myopathy: muscular dystrophy; X-Linked Progressive Retinal Atrophy XLPRA1; X-linked Progressive Retinal Atrophy XLPRA2; X-linked severe combined immunodeficiency; Zinc responsive dermatosis; ; Aniridia; Ankyloglossia; Anury (absence of tail); Aortic aneurysm; Aortic stenosis; Arnold-Chiari malformation; Arteritis; Aseptic meningitis; Asthma; Ataxia and myelopathy; Atherosclerosis; Atopic dermatitis; Atrial septal defect; Atrioventricular heart block; Attention deficit disorder; Autoimmune haemolytic anaemia; Autoimmune thyroiditis; Axonal neuropathy; Basset thrombopathia; B-cell non-Hodgkin's lymphoma; Beagle pain syndrome; Beta adrenoreceptor insensitivity; Bilateral sensorial deafness; Birt-Hogg-Dube syndrome; Black hair follicular dysplasia; Black skin disease; Blindness with ocular developmental anomalies; Bloat; Blue-eye; Bob-tail trait; Brachycephalic airway syndrome; Brachycephaly; Brachygnathia; Brachyury; Bradyarrhythmia; Brittle bone disease; Calcinosis circumscripta; Calcium excess mediated bone disease; Cancer; Canine adenovirus type 1 (CAV1) sensitivity; Canine hereditary multi-systems atrophy (CHMSA); Canine leukocyte adhesion deficiency (CLAD); Canine motor neurone disease; Cardiac arrhythmias; Cardiac valvular defects; Cardiomyopathy; Caroli's disease; Carpus subluxation; Catalase deficiency; Cataract; Central core myopathy; Centronuclear myopathy (cnm); Cerebellar and cerebral cortical degeneration; Cerebellar ataxia; Cerebellar ataxia - extrapyramidal abiotrophy; Cerebellar cortical abiotrophies; Cerebellar degeneration; Cerebellar degeneration (immune mediated); Ceroid lipofuscinosis; Ceroid lipofuscinosis type 2; Ceroid lipofuscinosis (ceroidal retinal degeneration); Cervical disc prolapse; Charcot-Marie-Tooth disease; Cherry Eye; Chondrodysplasia; Chondrodystrophia; Choroidal hypoplasia; Chronic pancreatitis; Chronic superficial keratitis; Chronic superficial keratitis of the cornea; Chronic valvular disease; Chylothorax; Ciliary dyskinesia; Ciliary dyskinesia (Kartagener's syndrome); Cleft palate; Clotting disorder; Cobalamin malabsorption; Coeliac disease; Collie eye anomaly (CEA); Colour dilution alopecia (CDA); Cone-rod dystrophy; Congenital adrenal hyperplasia syndrome; Comedones; Common variable immunodeficiency; Complement (C3) deficiency; Cone degeneration (cd); Congenital sensorineural deafness; Congenital sensorineural deafness with microphthalmia; Congenital Stationary Night Blindness (CSNB); Conotruncal defect; Conjunctivitis; Coonhound paralysis; Copper associated liver disease; Copper toxicosis; Cori disease; Corneal dystrophy; Corneal endothelial dystrophy; Corneal oedema; Corneal ulcers; Cornification and multiple congenital defects; Cornification defect; Cornifying epithelioma (Keratocanthoma); Cranial cruciate ligament rupture; Cranio-mandibular osteopathy; Cranioschisis; Cricopharyngeal achalasia; Cricopharangeal dysfunction; Cryptorchidism; Cushing syndrome (congenital); Cutaneous asthenia (Ehlers Danlos syndrome); Cutaneous lupus erythematosis; Cutaneous vasculopathy; Cyclic hematopoiesis; Cyclic neutropenia; Cysteine and urate uroliths; Cystic bone lesions; Cystine and urate uroliths; Cystinuria; Dancing Doberman disease; Degenerative encephalomyelopathy; Degenerative myelopathy; Demodicosis; Demyelination; Dermatitis; Dermatofibrosis (nodular); Dermatomyositis; Dewclaw; D-glyceric acidurea; D-glycericacidaemia; D-glycerate kinase deficiency; Diabetes; Diabetes mellitus; Diabetes mellitus (gestational); Diabetes insipidus; Dilated cardiomyopathy; Displaced canine teeth; Distal myopathy; Distal polyneuropathy; Distichiasis; Doberman hepatitis; Double Muscling; Dry eye; Dwarfism: pseudoachondroplastic dysplasia; Dyskinesia; Dyskinesia in pups; Dysphagia; Dysraphic spine; Dystocia; Ear Inflammation; Ectodermal dysplasia; Ectopia lentis; Ectopic ureters; Ectrodactyly; Ehlers Danlos syndrome; Elbow deformity; Elbow dysplasia; Elbow incongruity; Elliptocytosis; Emphysema with bronchial hypoplasia; Encephalitis; Encephalomyelopathy; Entropion; Epidermolysis bullosa; Epilepsy; Essential hypertension; Everted membrane nictitans; Exercise induced collapse; Exocrine pancreatic insufficiency; Factor I (Fibrinogen) deficiency; Factor II (Prothrombin) deficiency; Factor VII (Proconvertin) deficiency; Factor X (Stuart-Prower Factor) deficiency; Factor XI (Plasma Thromboplastin Antecedent) deficiency; Factor XII (Hageman Factor) deficiency; Familial focal seizures; Familial nephropathy; Familial renal disease; Fanconi syndrome; Fibrodysplasia Ossificans; Fibrinoid Leukodystrophy; Fibrosarcoma; Forbes disease; Fractures of humeral condyle; Fucosidosis (alpha); Galactocerebrosidosis; Galactosialidosis; Gastric carcinoma; Gastric dilatation/ volvulus; Gastropathy; Gaucher's disease I; Generalised tremor; Giant axonal neuropathy; Gingival hypertrophy; Glanzmann's-type I thrombasthenia; Glaucoma; Glaucoma - pigmentary; Glaucoma - secondary; Glaucoma with ciliary body cysts; Globoid cell leukodystrophy; Glomerulonephropathy; Glomerulonephritis; Glucosuria; Glutathione-S-Transferase deficiency; Gluten sensitive enteropathy; Glycogen storage disease Ia (von Gierke disease); Glycogen storage disease II (Pompe disease); Glycogen storage disease type IIIa; Glycogen storage disease IV; Glycogen storage disease VII, (Phosphofructokinase deficiency); GM1 gangliosidosis; GM2 gangliosidosis; GM2 gangliosidosis (type AB) (Tay Sachs disease, AB variant); GM2 gangliosidosis (type B) (Sandhoff disease); Goniodysgenesis; GSTT1 deficiency; Grey matter spongy degeneration; Guillaine Barre syndrome; Haemophilia A; Haemophilia B; Hair loss; Hairless, defective teeth; Hairless, small litter size; Halothane sensitivity; Hemeralopia; Hemimelia; Hemivertebrae; Hemophagocytic histiocytic sarcoma; Hemophilia; Hepatitis (chronic active); Hepatocerebellar degeneration; Hepatoportal microvascular dysplasia; Hereditary ataxia; Hereditary myelopathy; Hereditary myopathy; Hereditary necrotizing myelopathy; Hereditary nephritis; Hereditary polyneuropathy; Hereditary spinal muscular atrophy ("Canine motor neurone disease"); Hereditary ventricular tachycardia; Hexosaminidase B deficiency; High K erythrocytes; Hindlimb lameness; Hip dysplasia; Histiocytic sarcoma; Histiocytic ulcerative colitis; Horner's syndrome;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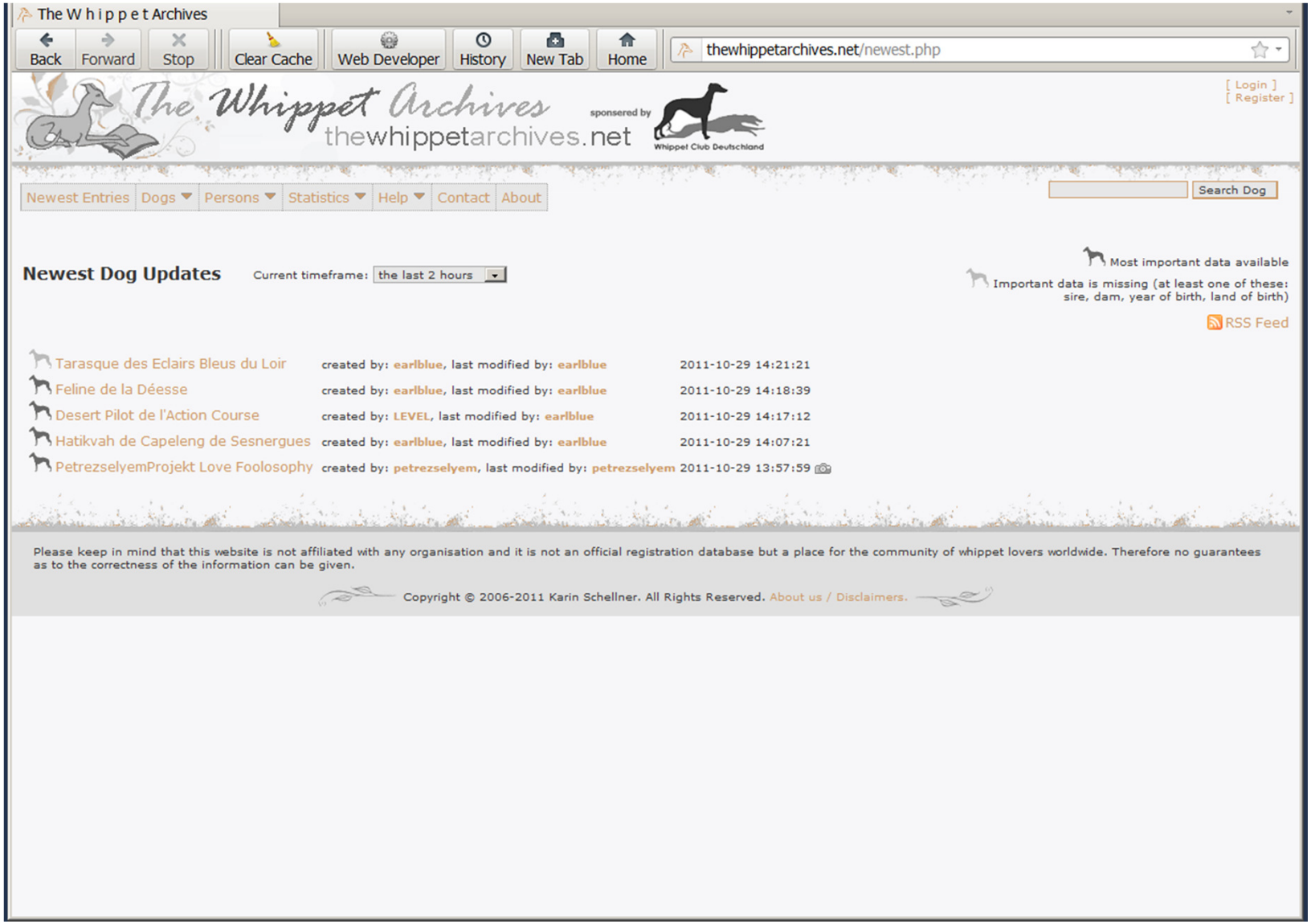
About TWA
TWA stands for "The Whippet Archives". TWA is an international initiative to collect and preserve as many whippet pedigrees and data as possible, in order to give a good view of the breed and show developments in the breed, past and present, to allow whippet owners to discover the ancestry of their beloved pets, and to provide pedigree information to help breeders planning future litters and generations of whippets.
TWA is a user-driven database site with some supervision and editing by TWA administrators and TWA crew members.
Anyone who has an Internet connection may freely browse the site and look at the information that has been collected and that is made available. However, to add, edit or remove information you must first be registered with TWA.
The principle of TWA is to give registered users the possibility of collaboratively building up an informative database on whippets. TWA has succeeded in this very well. Founded in 2007, thewhippetarchives.net is the web's largest site dedicated to Whippet pedigrees with nearly 70.000 entries collected in only 2 years. This kind of large database is possible only with the help of users and whippet enthusiasts worldwide willingly and collaboratively sharing the information they have with TWA and each other.
Due to the fact that TWA is a user-driven database there is always the possibility that the database includes incorrect information. Moreover, the accessible, open nature of the database holds the potential for both vandalism and inaccuracy. However, the advantages of this kind of large database are significant and clearly outweigh the disadvantages.
It is our goal, with the help of active users and TWA admins and TWA crew members who are monitoring contributions on a regular basis, to correct errors quickly. Over time the accuracy of this site is improving as it attracts more and more contributors. We encourage all registered users to help us maintain the high standards we have set for TWA by correcting information where needed and passing on information and pedigrees for the benefit of all users.
We have instituted a process of change-logs which will allow us to identify and follow up any time a member has modified entries on the site. If it turns out that someone has deliberately altered correct entries or in any way purposely sabotaged entries on the database by adding incorrect information this person will be excluded from the site.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Current timeframe:
the last 2 hours
Most important data available
Important data is missing (at least one of these: sire, dam, year of birth, land of birth)
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Tarasque des Eclairs Bleus du Loir created by: earlblue, last modified by: earlblue 2011-10-29 14:21:21
Feline de la Déesse created by: earlblue, last modified by: earlblue 2011-10-29 14:18:39
Desert Pilot de l'Action Course created by: LEVEL, last modified by: earlblue 2011-10-29 14:17:12
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Please keep in mind that this website is not affiliated with any organisation and it is not an official registration database but a place for the community of whippet lovers worldwide. Therefore no guarantees as to the correctness of the information can be given.
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Feline de la Déesse

no photo available

Registered Name: Feline de la Déesse
Breeder:
Owner:
Kennel:
Sire: Ribot de la Déesse
Dam: Allez Paulette Coeur de Lion
Call Name:
Sex: female
Date of Birth: 8 APR 1990
Date of Death:
Land of Birth: France
Land of Standing: France
Size:
Weight:
Colour:
Distinguishing Features:
Titles:
Known Offspring:

Siblings:
Douchka de la Déesse ♀
Foudre de la Déesse ♀
Fourasi de la Déesse ♂

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Generations in pedigree 3

Printable version of pedigree
(with / without images)

HTML code for this pedigree
(e.g. to embed on your private website)

Pedigree Analysis

Pedigree

Belgium Ch

Feline de la Déesse France 1990	Ribot de la Déesse Black France 1980	 Imprévu de la Déesse France 1973	Belgium Ch  Phébus de la Déesse France 1966
			Réole du Clos des Ardents Black France 1968
		On s'Aime de Coeur de Lion France 1978	Joli Garçon Coeur de Lion France 1960
			Zilver Stern de Toutankhamon Belgium
	Allez Paulette Coeur de Lion Blue France 1985	The Boss Coeur de Lion France 1982	multi-champion (see notes)  Lucky Boy the Grashopper Black Germany 1976
			Lux Ch  Marigold France 1976
		Saint Etienne Nantes Coeur de Lion France 1981	Noix de Coco Coeur de Lion France 1977
			Jolie Rose Coeur de Lion France 1974

Breeding for conservation

- Selection of Animals
  - Founder alleles (old practice)
  - Mean kinship (mainly zoo's)
  - Optimal contributions (current 'best practice')
- Mating of Animals
  - Avoidance of inbreeding
    - => Effective population size: $N_e = 1 / 2\Delta F$