Intensive management of the European mink, *Mustela lutreola*

Life Lutreola 3rd workshop
Spain

Zaragosa
15. June 2016

Tiit Maran

IUCN SSC Species Survival Commission

IUCN/SSC Small Carnivore Specialist Group

LUTREOLA

ZOO

Content of the Talk

- Current global status of the European mink
- Intensive management:
  - *Ex situ* conservation
  - Translocations

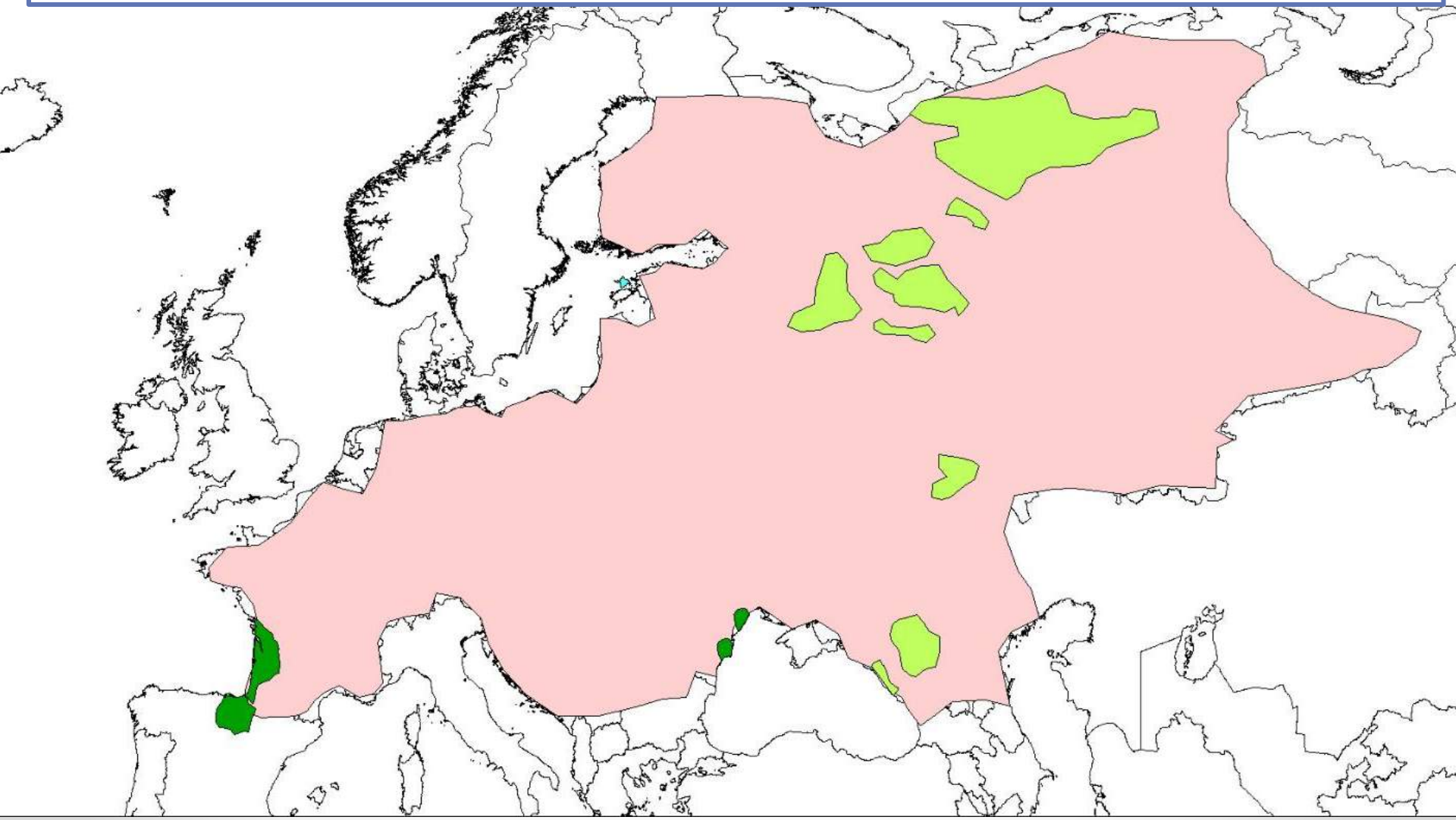
European mink status

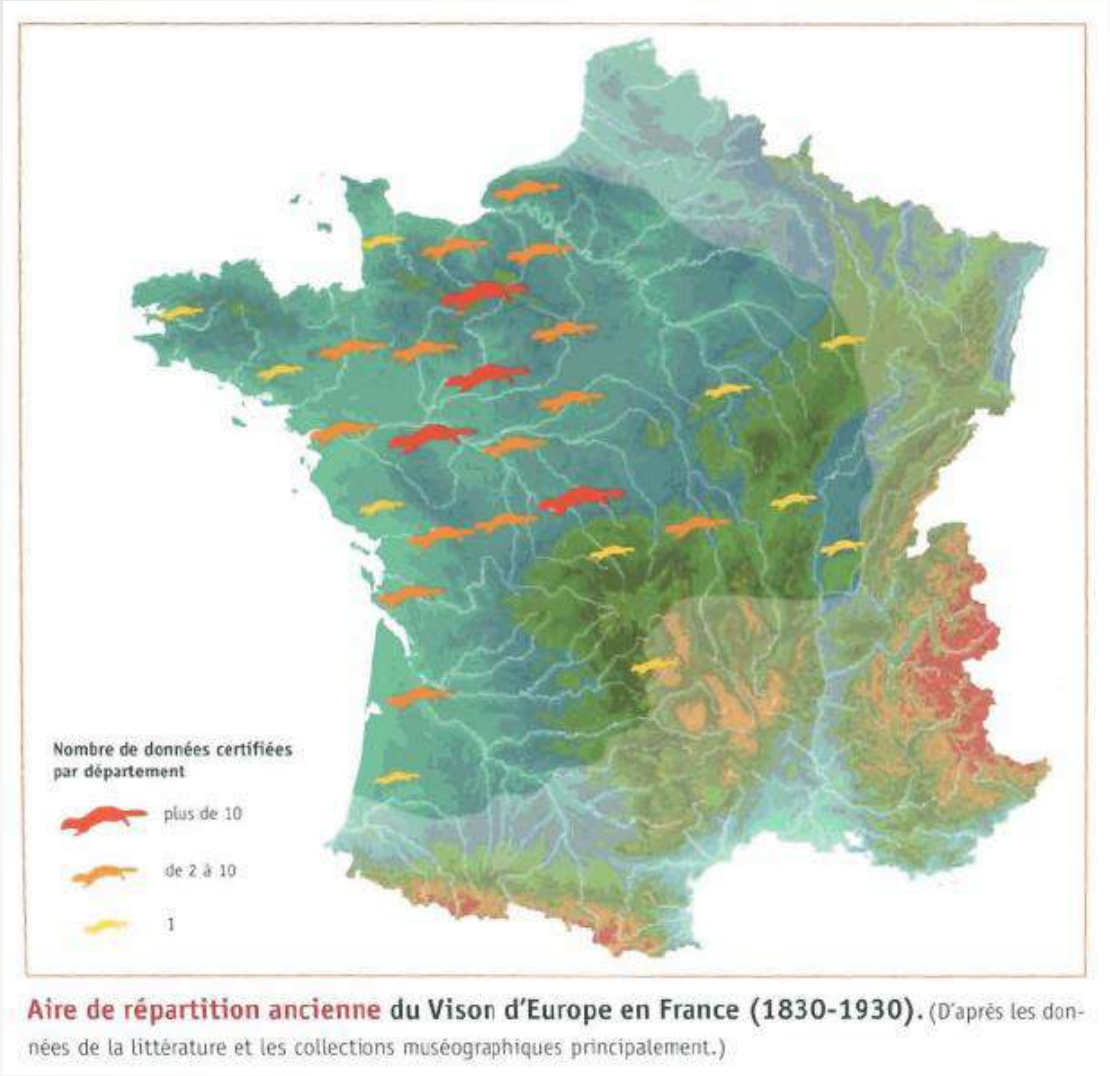
EU Country highlights: France, Germany, Romania, Estonia

Current and historical range

NB! No viable populations in Russia

- Documented wild animals
- Possibly something survives
- Established population
- Historical range





Aire de répartition ancienne du Vison d'Europe en France (1830-1930). (D'après les données de la littérature et les collections muséographiques principalement.)

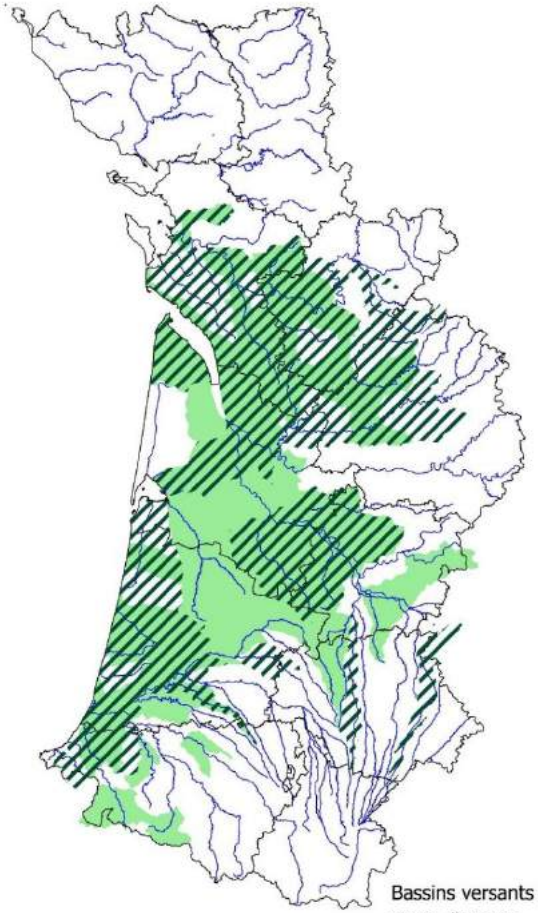
France

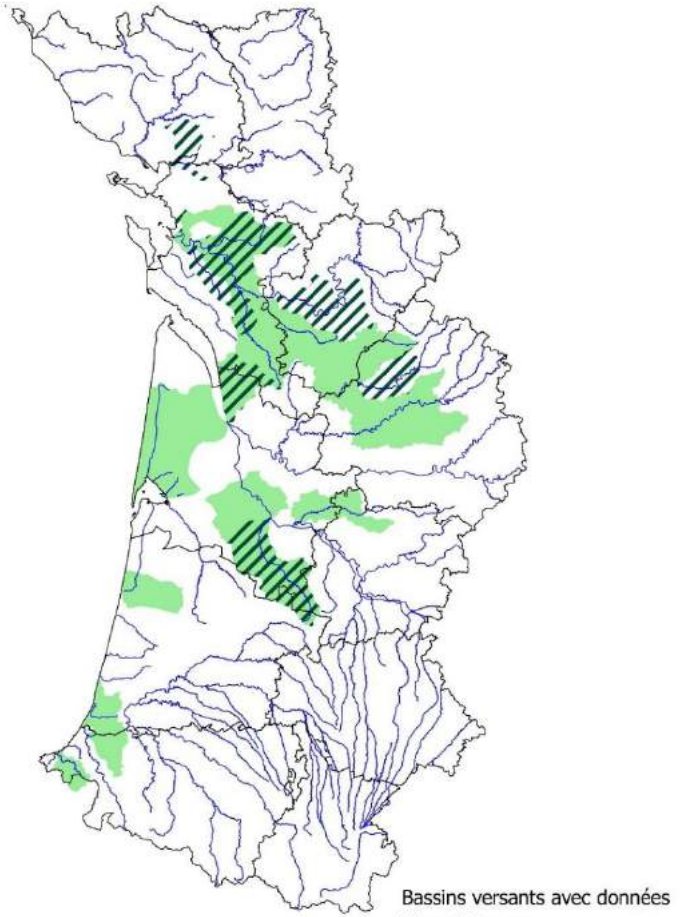
France: range data …

Amink 1980s

Amink 1990s

Amink 2000 - 2014





European mink distribution data

Germany

Nerz Geschichte .....

Extinct for 20th century

Release of mink since 2010

- 2010 - 2014 some 20 – 30 mink released yearly from breeding station

2015: First record of wild born mink in Germany !!!!

Romania

...


Galați
Cahul
Odesa
Harta Județului
Tulcea
Brăila
Tulcea
Rezervația Biosferei
Delta Dunării
Tiit Maran
Estonia
Madis Põdra
Spain
Pascal Fournier
France

European mink in Danube

- The estimate of minimum population **size 1000 -1500 ind.**

Most viable population in the world

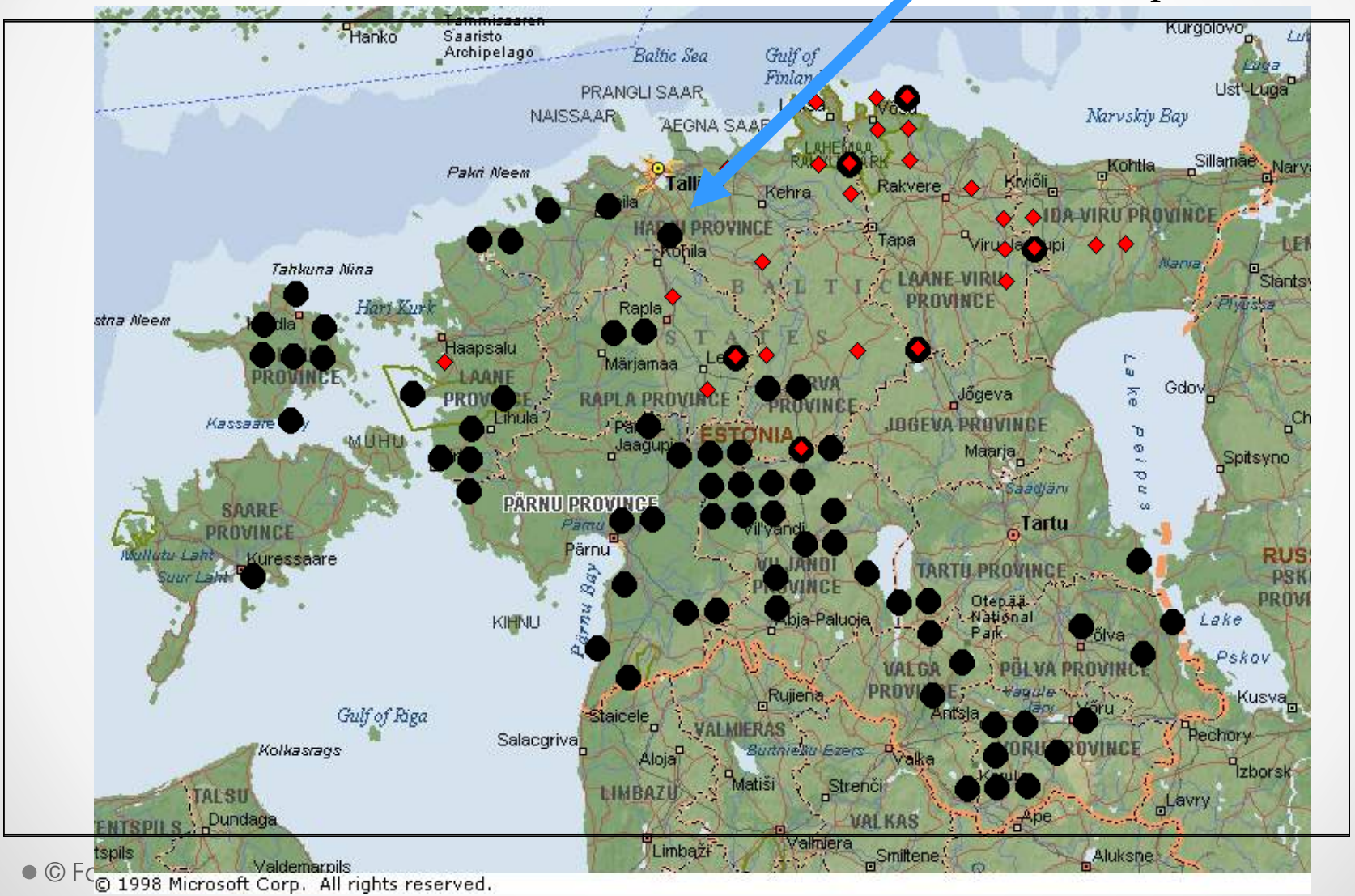
… danger is looming not far ……

Growing number of mink farms

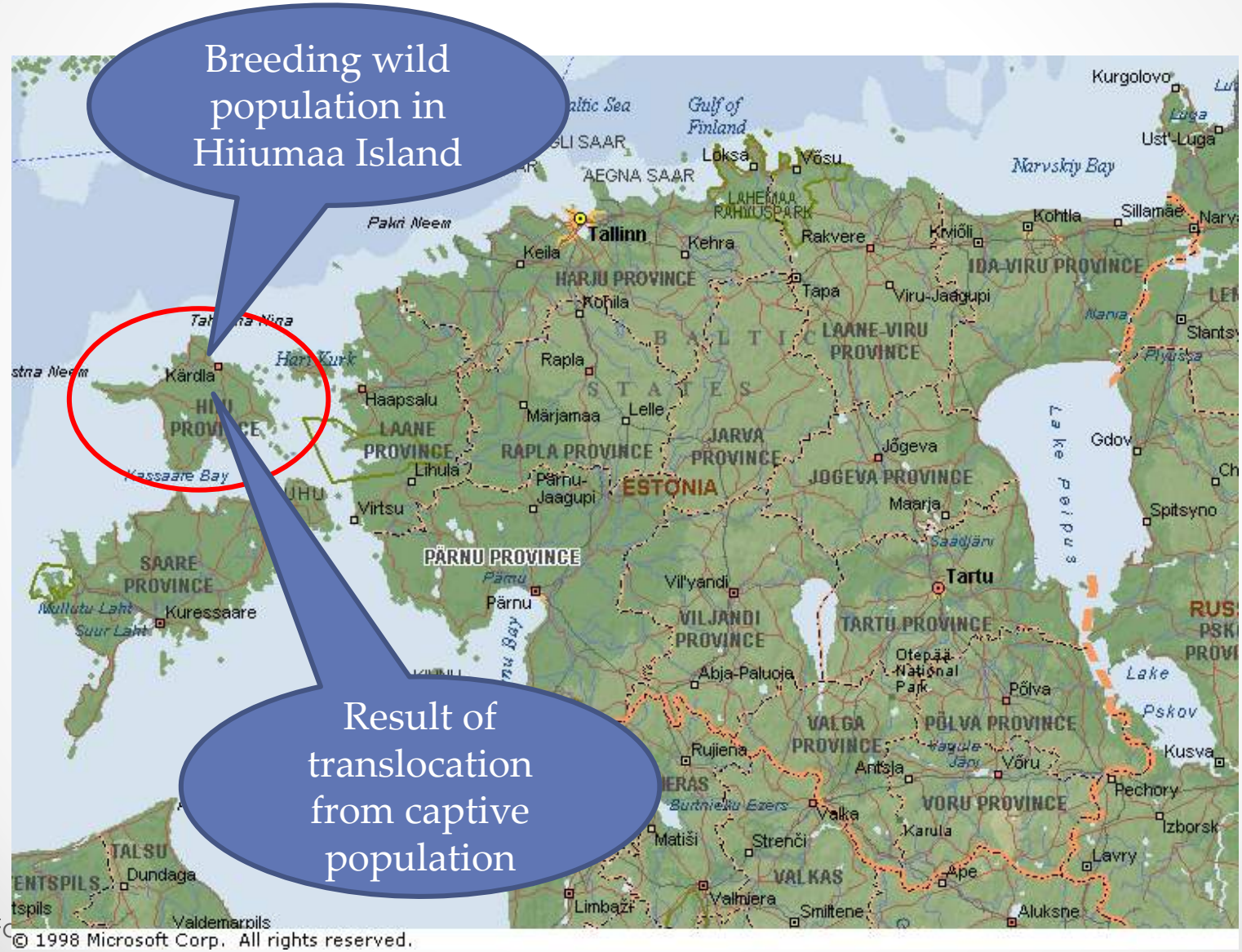
American mink invasion - almost impossible to reverse once reality

Estonia

Status: 1985 - 1991



Status: 2014 - 2016



C vation status

The MOST ENDAGERED SMALL CARNIVORE in the world!!!!!

ONLY IN EUROPE

ngered

IV (Priority Species)

IUCN Action Plan for Small Carnivor

ONE OF THE MOST ENDANGERED MAMMALS IN EUROPE

Conver

National Legislations

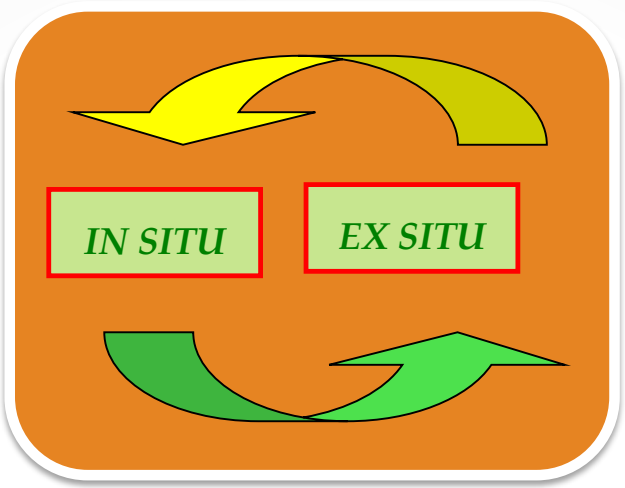
- Russia ! ! ! !

Intensive management today as tommorrow is too late !!!!

Intensive management – Why?

Conventional protection measures like area protection and limitations in use are not sufficient

Need to think „FREE of STEREOTYPES“ !!!!



Ex situ conservation

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Management out of natural context

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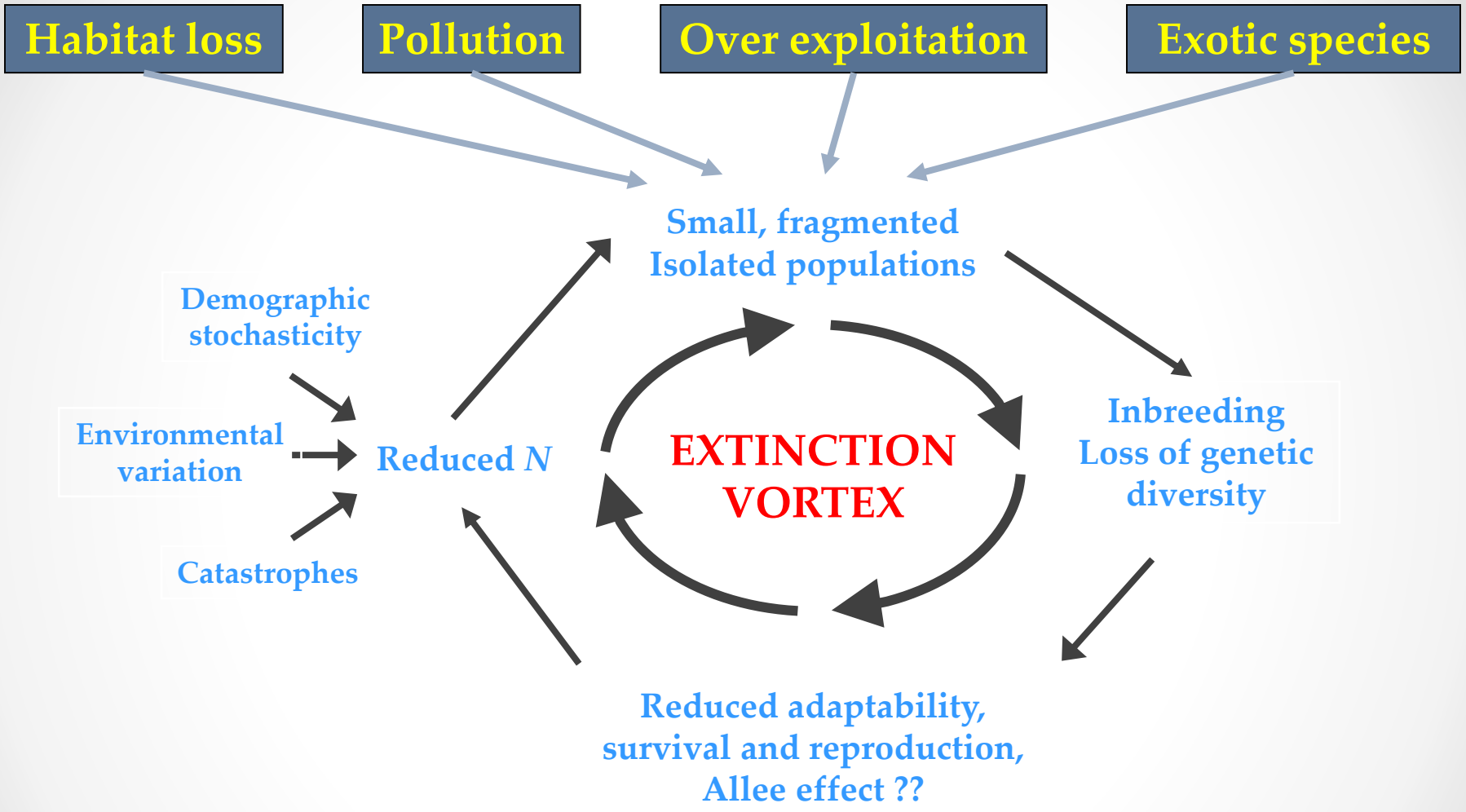
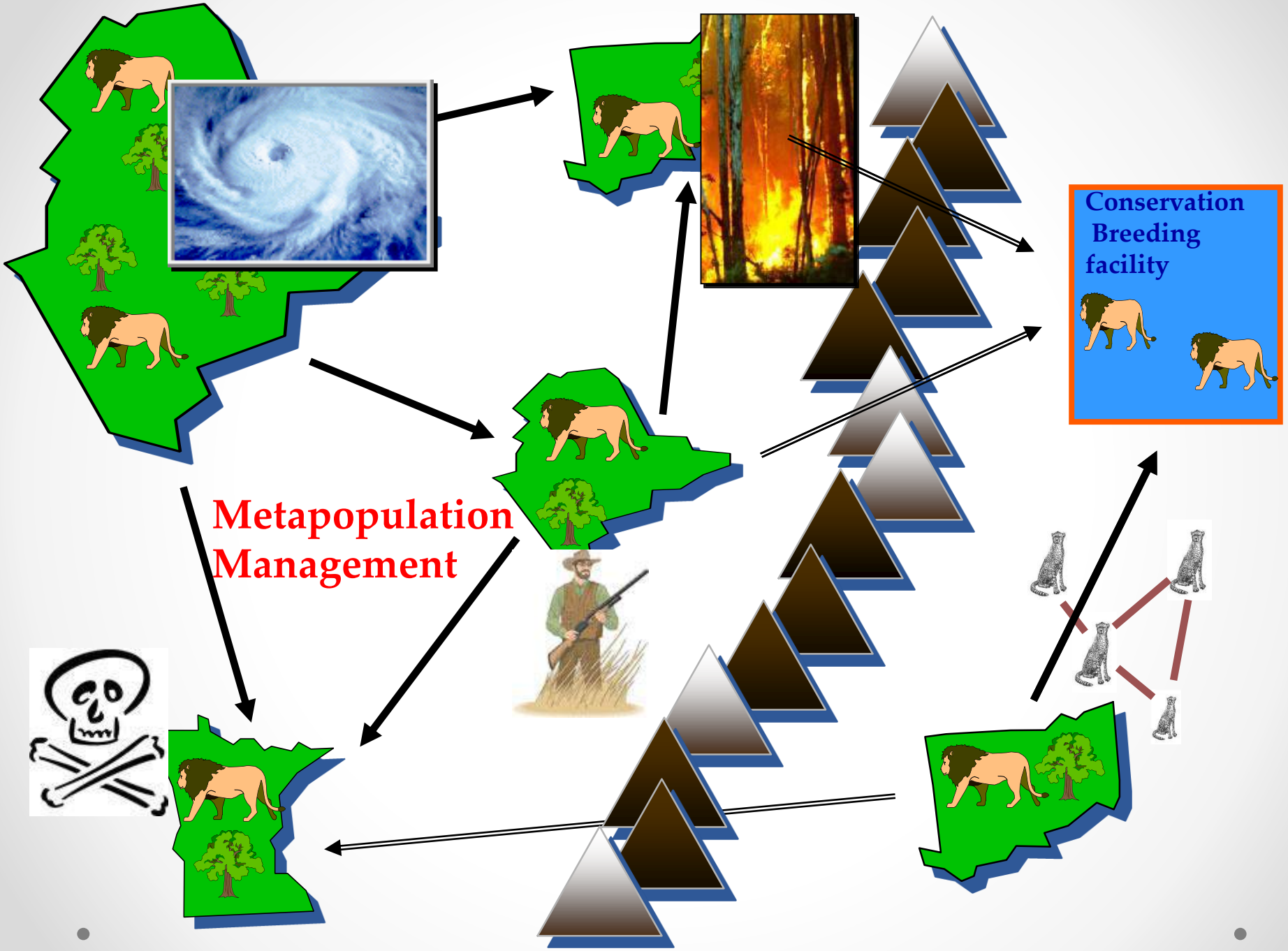
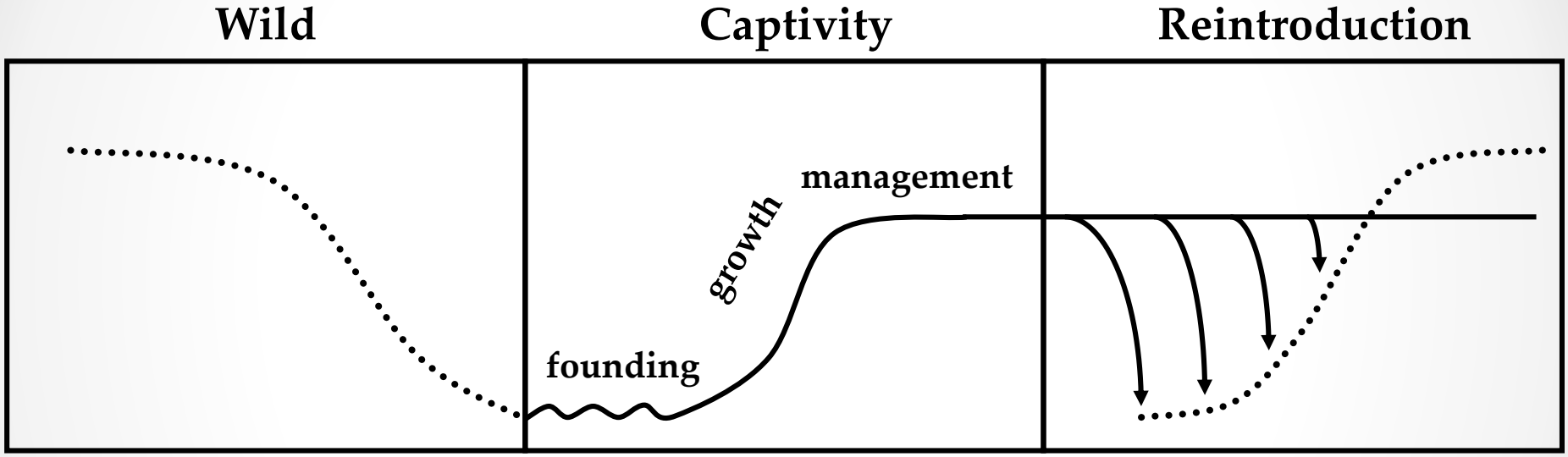
Management of small populations

Demography
&
Genetic diversity

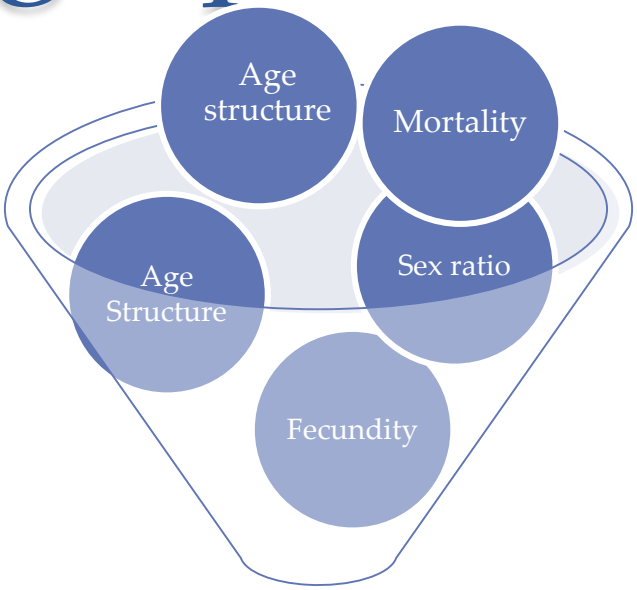

Habitat loss
Pollution
Over exploitation
Exotic species
Small, fragmented
Isolated populations
Demographic
stochasticity
Environmental
variation
Catastrophes
Reduced N
EXTINCTION
VORTEX
Inbreeding
Loss of genetic
diversity
Reduced adaptability,
survival and reproduction,
Allee effect ??


Conservation
Breeding
facility
Metapopulation
Management

Wild populations, captive breeding and reintroduction programs



Demographic concerns



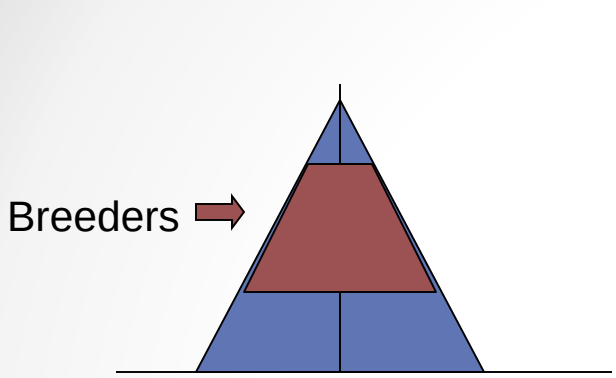
Demographic health of small popualion

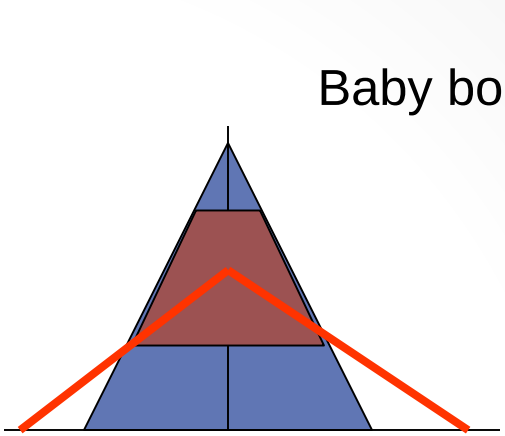
< 25 - 50

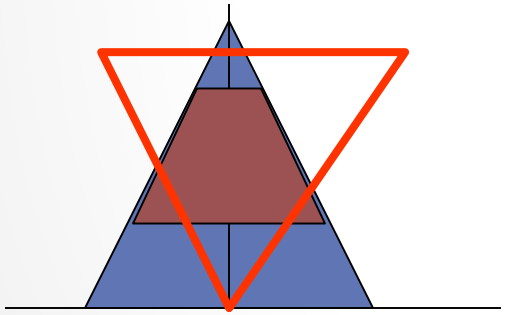
Size of population

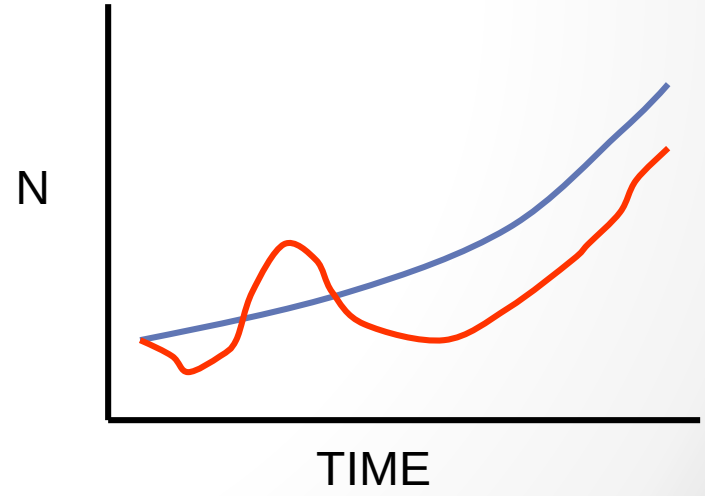
> 50

Effect of Age Structure of future growth...









TYPICAL AIM FOR ZOOS, NOT USUALLY FOR IN SITU ORIENTED PROGRAMS

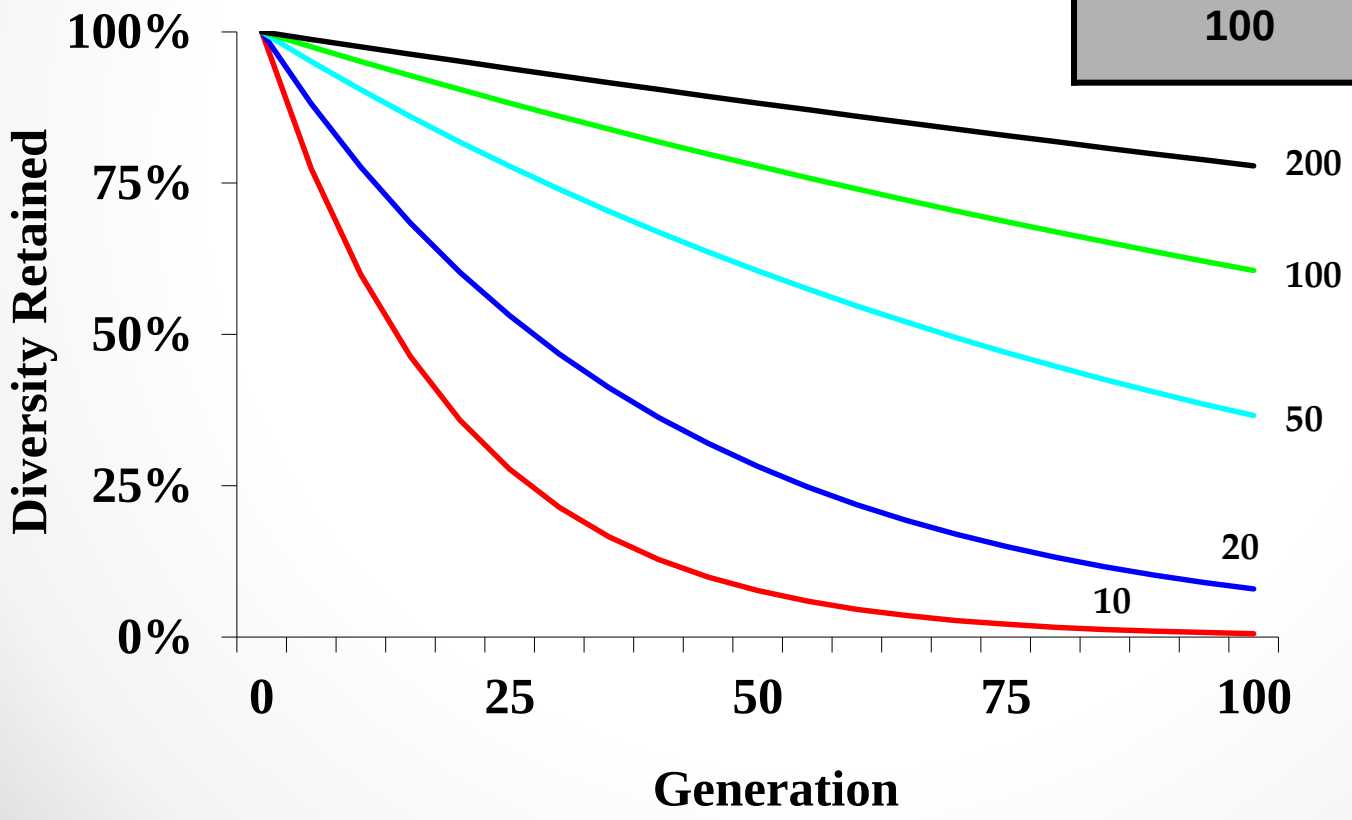
PRESERVING GENES BROUGHT IN BY FOUNDERS

• • •

- Retain 90% of the source gene diversity for 100 years

Rate of genetic diversity loss is determined by the population's Effective Population Size (N_e)

Effective size (N_e)	Loss per generation
5	10%
50	1%
100	.5%

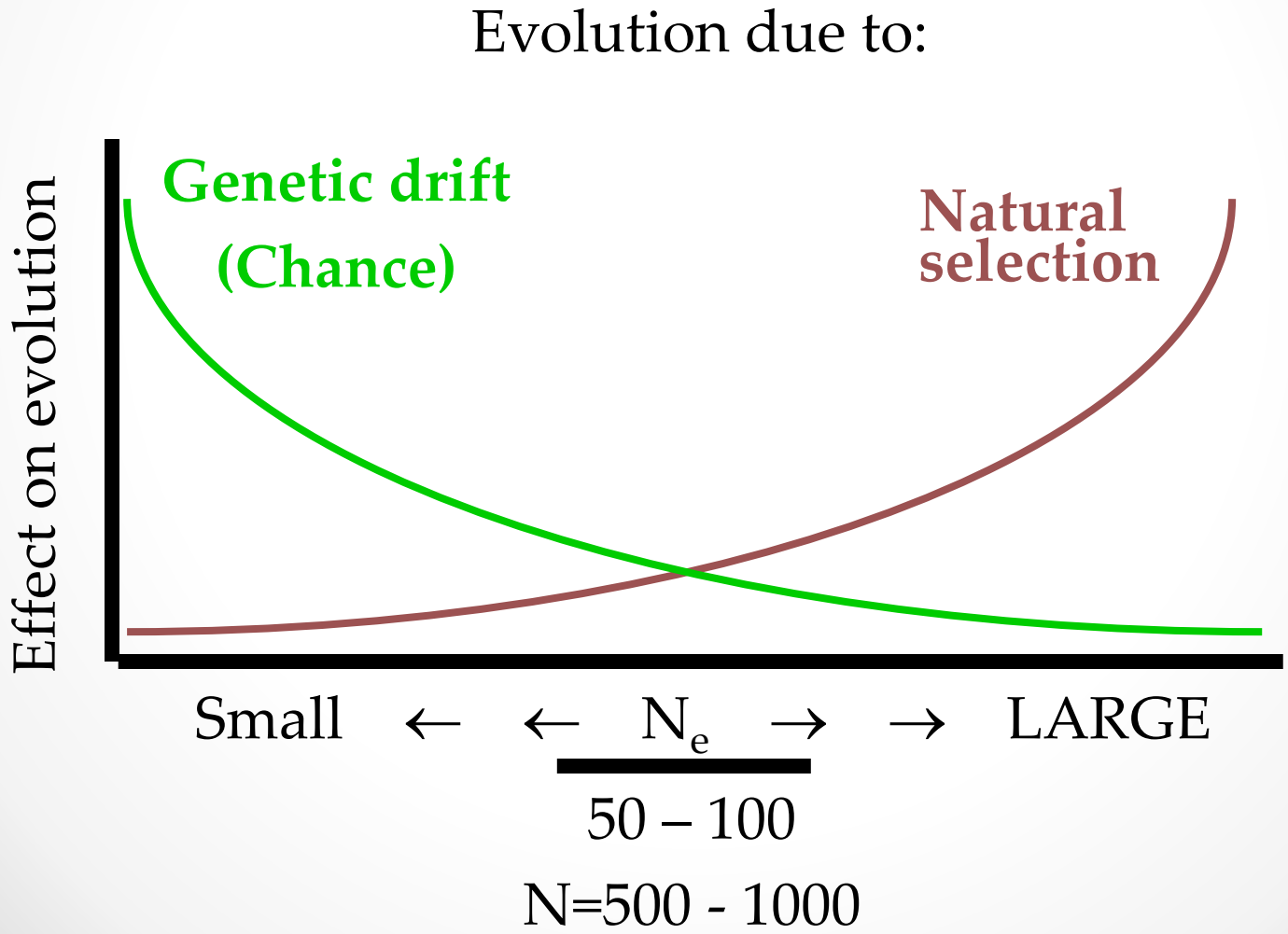


Effective Population Size Ne !

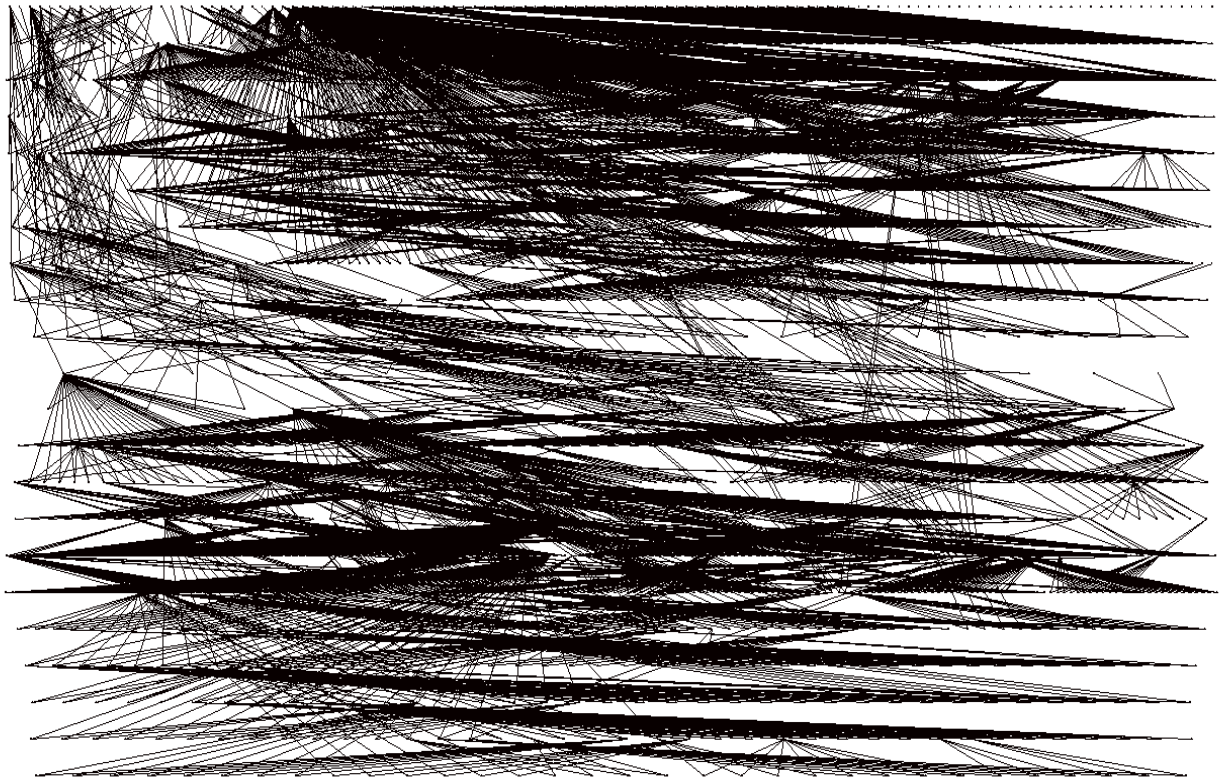
Real captive population = ~ 3 x Ne

Addressing the challenges

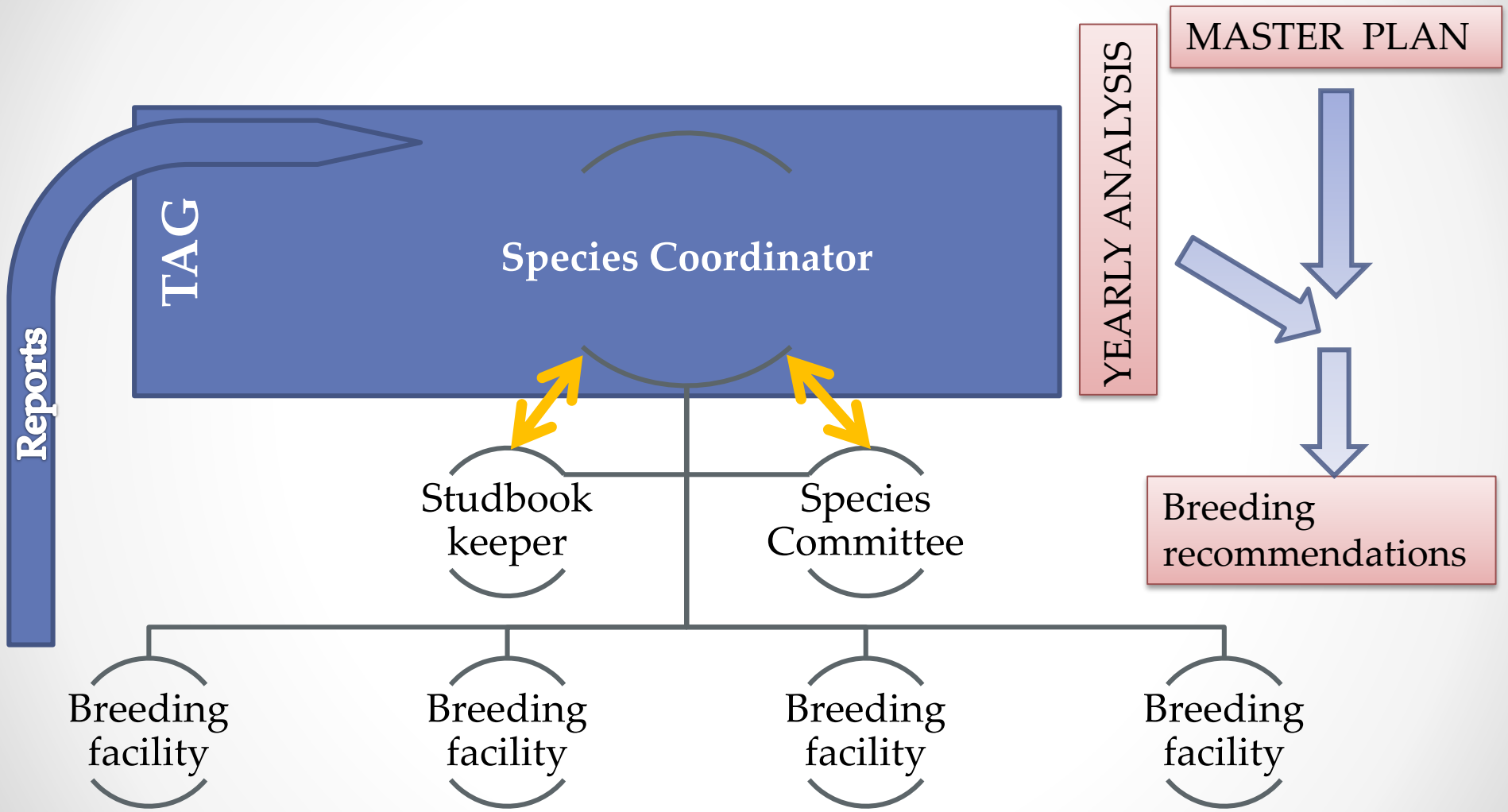
How large to allow natural selection to dominate genetic drift?



Full pedigree of European mink captive population in 2006



Structure of EEP program



Review of *ex situ* conservation of the European mink

European mink in captivity - the history

- First records of European mink in captivity:
  - Berlin Zoo: von Schmidt, 1865
  - Livland: Löwis 1885, 1886

Breeding in captivity – before or parallel with EEP programme

- **First breeding in captivity - Moscow Zoo 1933**
- Novosibirsk Biological Institute breeding program 1970s – 1990s (Russia)

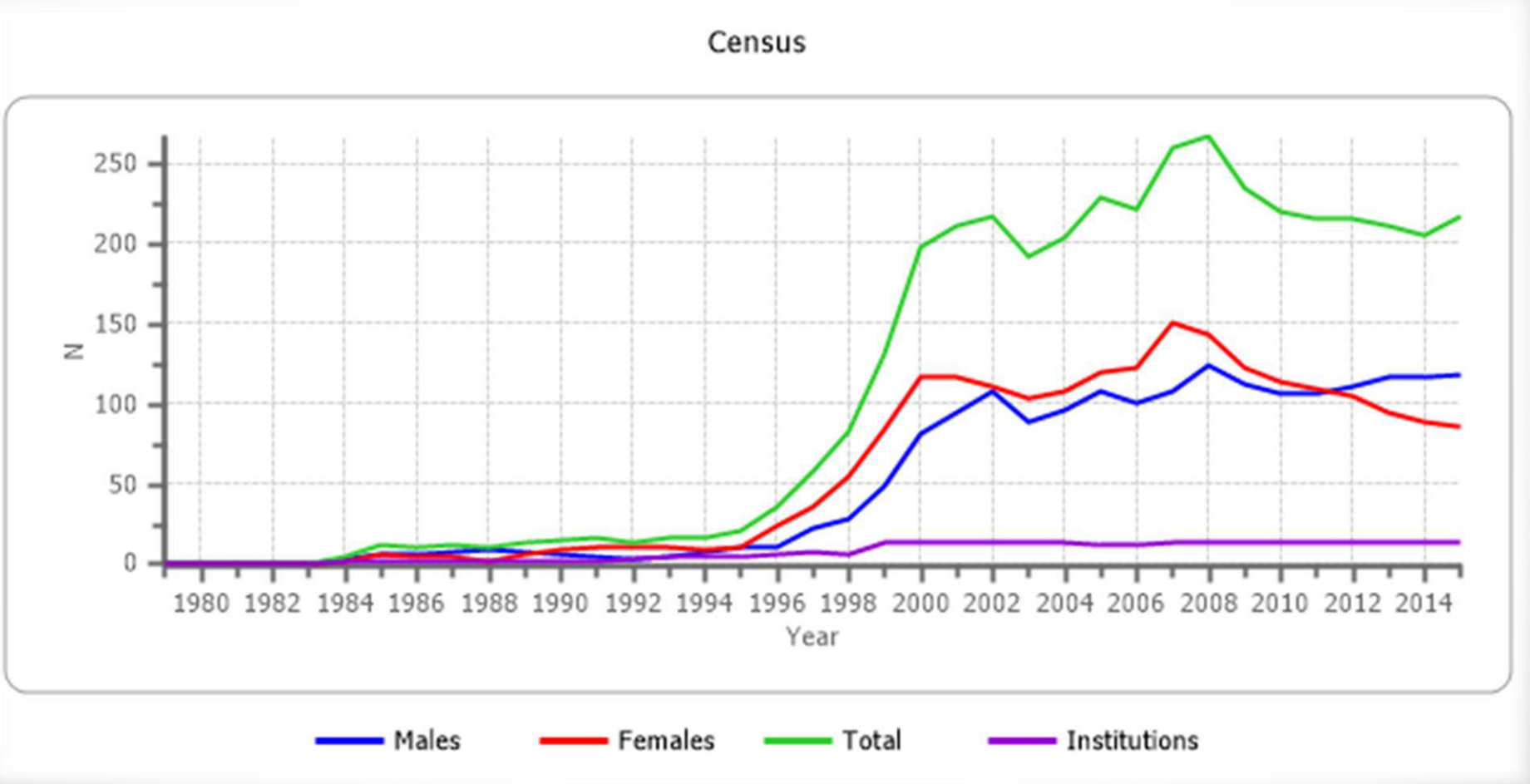
  Astrakhan operation (Russia) 1977 – 1990s – Dr. Moshonkin – STOPPED
- Novisibirsk Zoo (Russia) 1990s – 2000s – director Shilo STOPPED
- Severtsov Institute of Ecology IEMEZ (Russia) – Dr. Rozhnov - STOPPED
- Central Forest Biosphere Reserve (Russia) – Vl. Katchanovsky – STOPPED
- Ural initiative – Dr. Kiseleva ? Stopped

Biological institute in Novosibirsk (Russia)

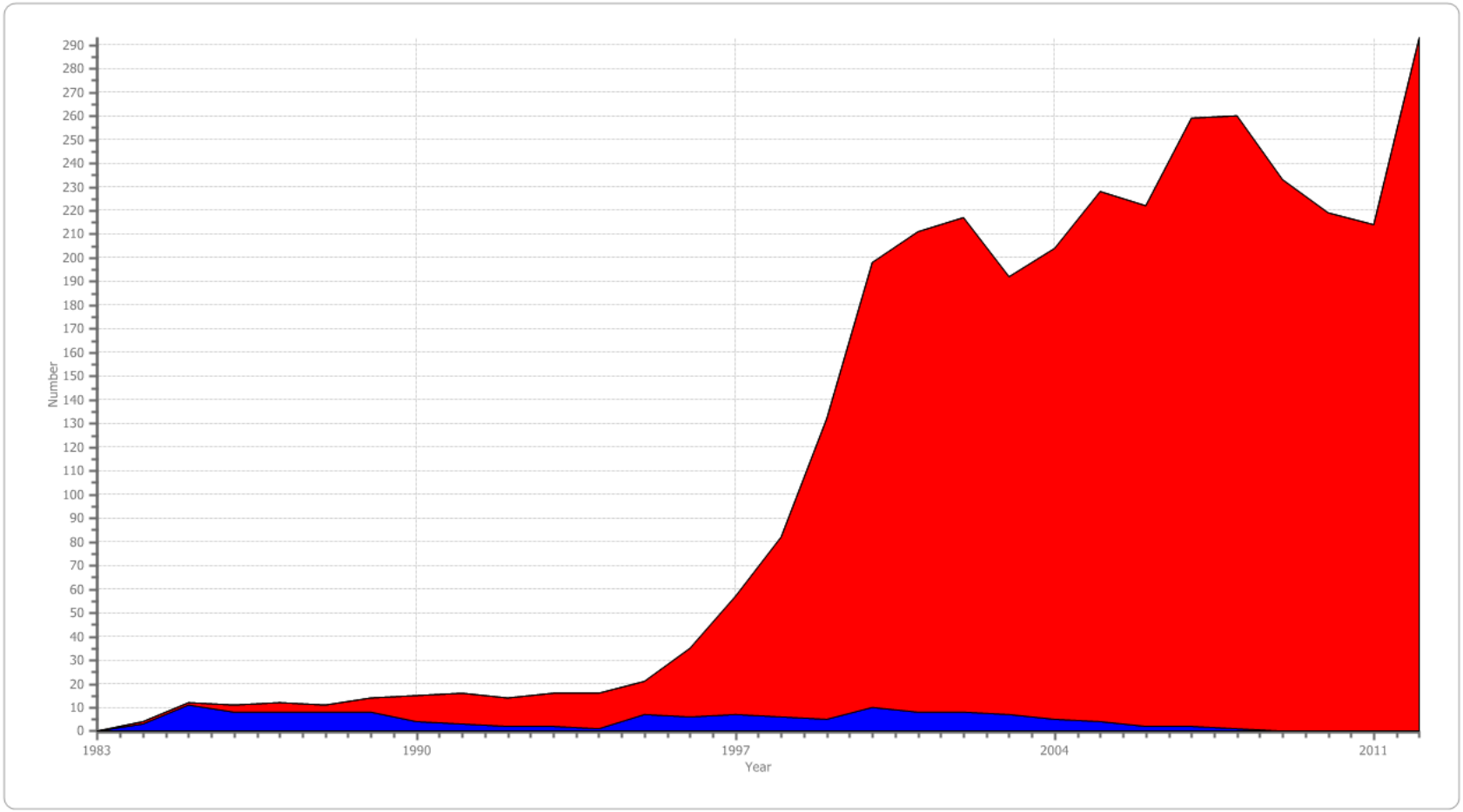
- Dr. Dimitri Ternovski
- **!ntrageneric hybrids** for fur-farming – honorik etc
- Founders: Leningrad, Tver, Novgorod, Vologda, Pskov Regions and Estonia
- 19 (9.10) founders
- 1972 – 1992 1170 (**579.582**) offspring
- Birth from 119 females and 38 males

- Results of the activity:
  - Two most comprehesive **books** on mustelid biology in Russian
  - **Reintroduction** efforts in Kuril Islands: **Iturup and Kunshir**
  - **Reintroduction** efforts in **Shingindira River** in Tadjiikistan

Census of EEP Population: sex



Census of EEP Population: origin



European mink EEP in figures as of 01.06.2016

- Most earlier record from **early 20th century**
- **EEP** since **1992**
- Total no of **individuls recorded: 3067**
- No of **birth** events recorded: **2139**
- No of **death** events recorded: **868**
- No of generations in captivity:
  - Minimum **4,07**
  - Average **6,6005**
  - Maximum **14,85**
  - Absolute potential maximum 27

EEP population: STATUS

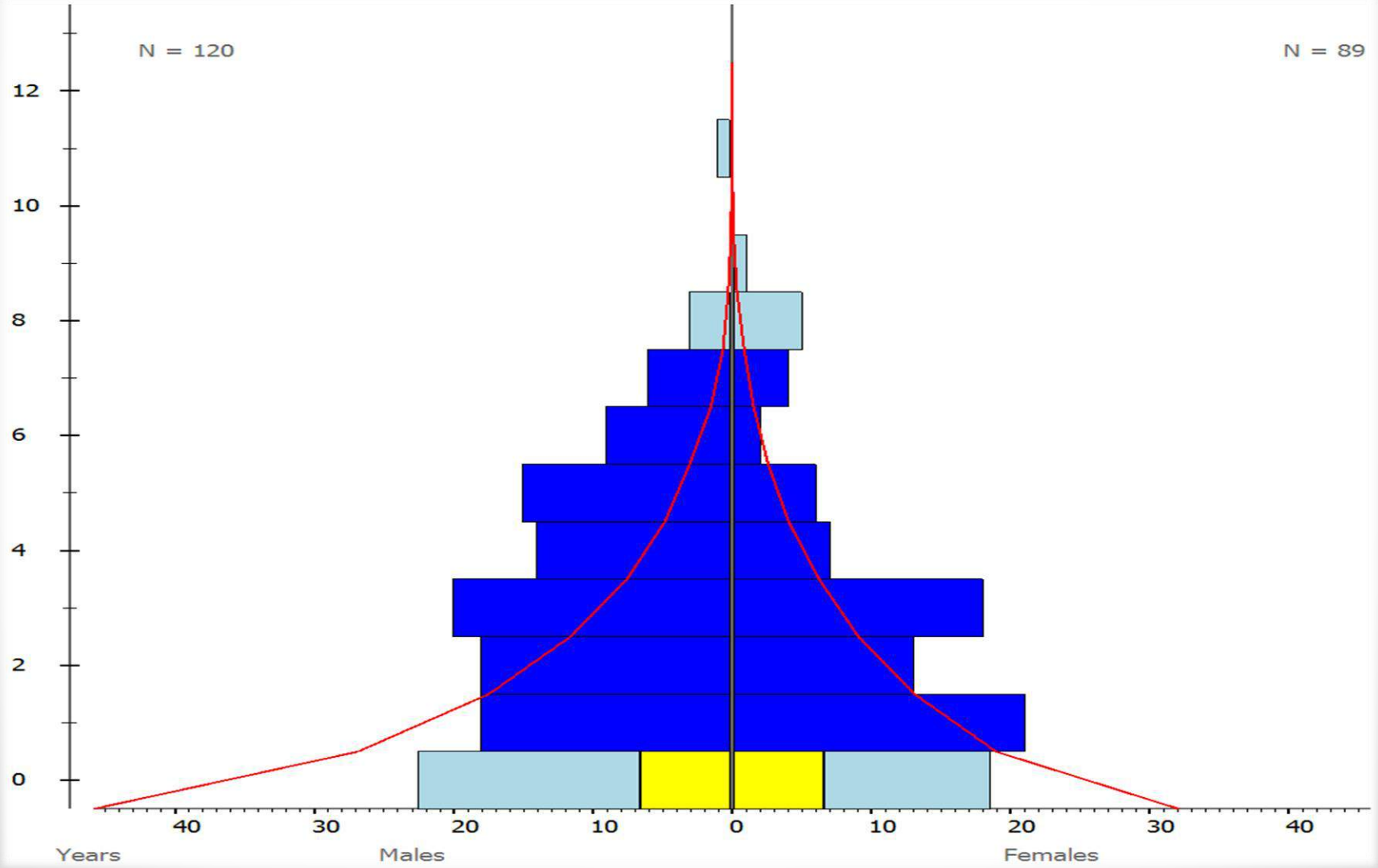
2015

Release + Surplus

EUROPEAN MINK EEP REPORT (2015)

Institution	Status (2015-01-01)			Births			DNS			Transfer EAZA in			Transfer EAZA out			Transfer Non-EAZA in			Transfer Non-EAZA out			Deaths			Status (2015-12-31)		
	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U	M	F	U
Ahtari	2	3	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0
Bojnice	2	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**	**2**	0
Calviac	2	3	0	0	0		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**2**	**3**	0
Chomutov	1	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0
Decin	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	**0**	**1**	0
Euronerz	33	28	0	16	13	11	0	0	0	0	0	0	0	0	0	0	0	0	11	7	2	11	11	9	**27**	**23**	0
Helsinki	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**	**2**	0
Kerkrade	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**0**	0
Pavlov	3	3	0	0	0	0	0	0	0	0	1	0	2	2	0	0	0	0	0	0	0	1	0	0	**0**	**2**	0
Poznan	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**	**1**	0
Ranua	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0
Riga	2	6	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**4**	**5**	0
Tallin	66	39	0	31	23	1	0	0	0	1	0	0	5	3	0	0	0	0	21	20	0	5	3	1	**67**	**36**	0
Zoodyssee	0		0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**	**1**	0
	11	87	0	47	36	12	0	0	0	9	7	0	9	7	0	0	0	0	32	27	2	19	17	10	Total		
	2	7																							**111**	**79**	**0**
Sachsen	2	2																							Cross-check		
Wisentgeh	1	0																							111	79	0

Age ja sex pyramid as of 2015



Demographic Summary

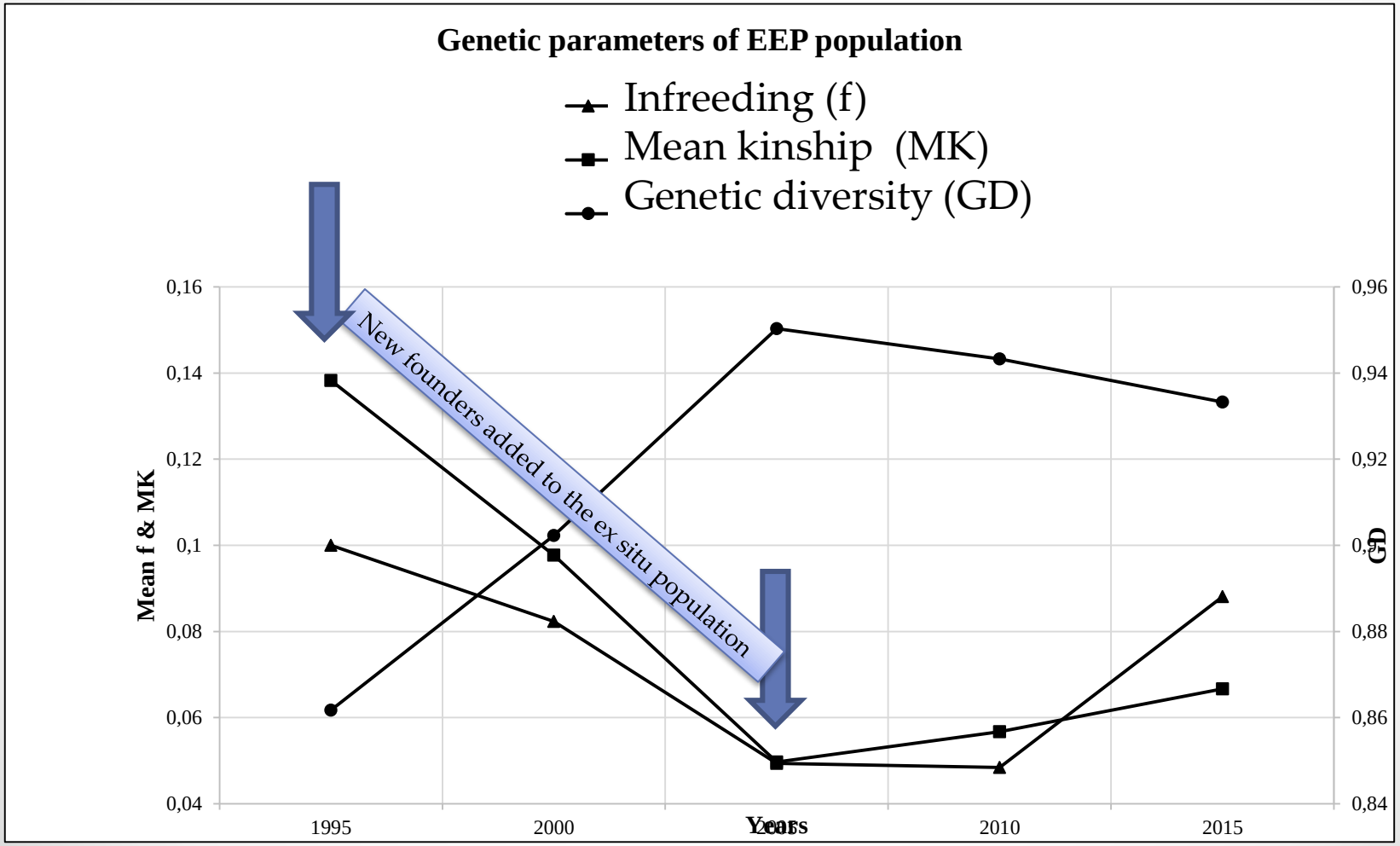
Life Expectancy	5,0	
30 day mortality	**0,05**	**(N=1958)**
25% live to	7,2	
10% live to	8,8	
5% live to	9,7	
1% live to	∞	
Oldest living	11,7	(ID:1450)
λ	**1,309**	
r	0,269	
R0	1,830	
T	**2,2 years**	

Average litter size in 2016 – 5,4

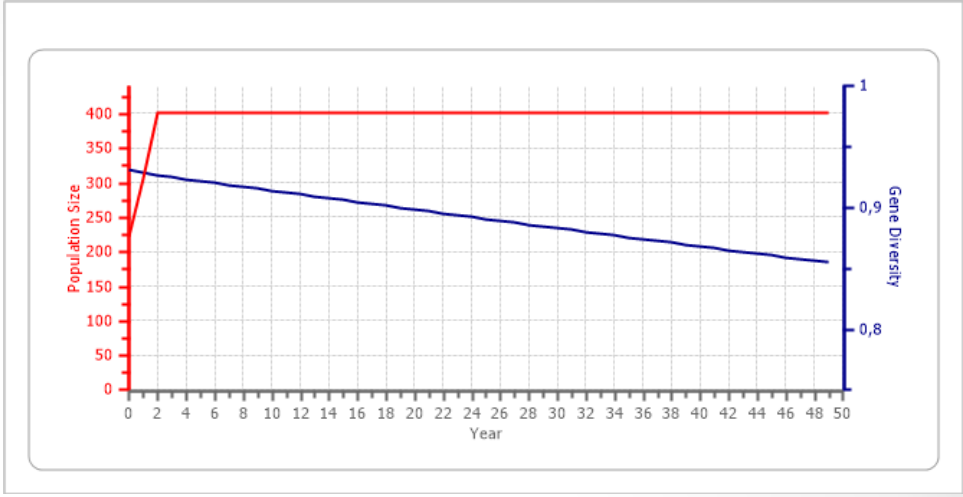
Genetic Summary

Founders	**22**
Potential (additional) Founders 0	
Living Animals	222
Living Descendants	199,96
% Ancestry Known	**90%**
% Ancestry Certain	90%
Gene Diversity	**0,9314**
Population Mean Kinship	**0,0686**
Gene Value	0,9315
Founder Genome Equivalents	7,29
Founder Genomes Surviving	10,94
Potential Gene Diversity	0,9543
Mean Inbreeding	**0,0901**
Ne/N	**0,3380**

Genetic parameters of EEP population



Population Goal



Retain 85% of the Gene Diversity for 50 years

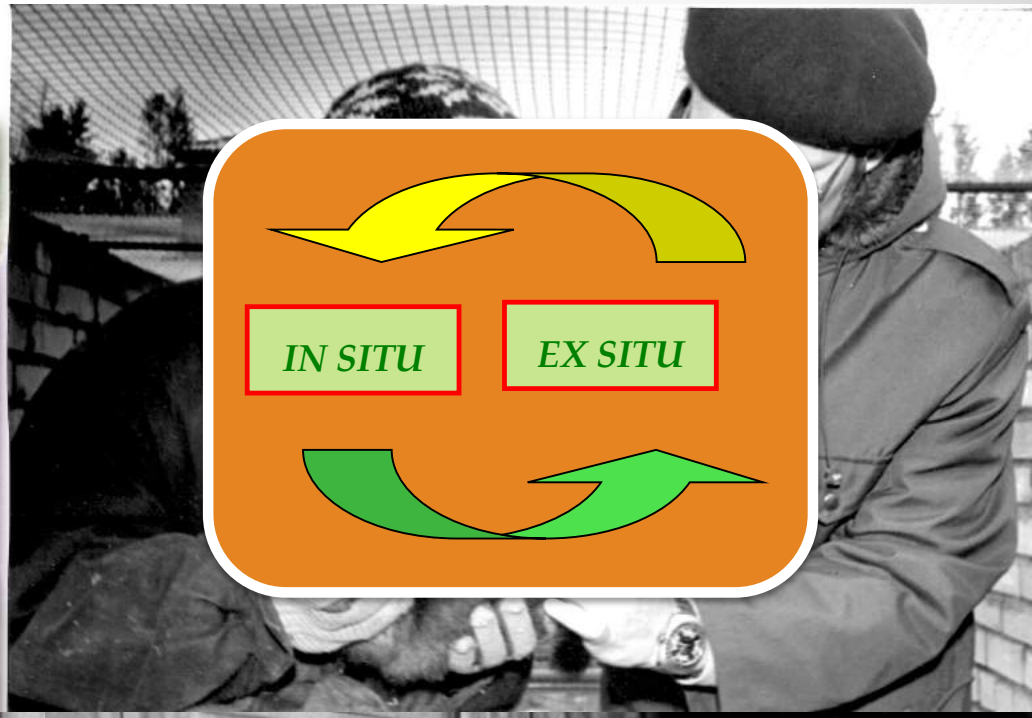
Population Variables:

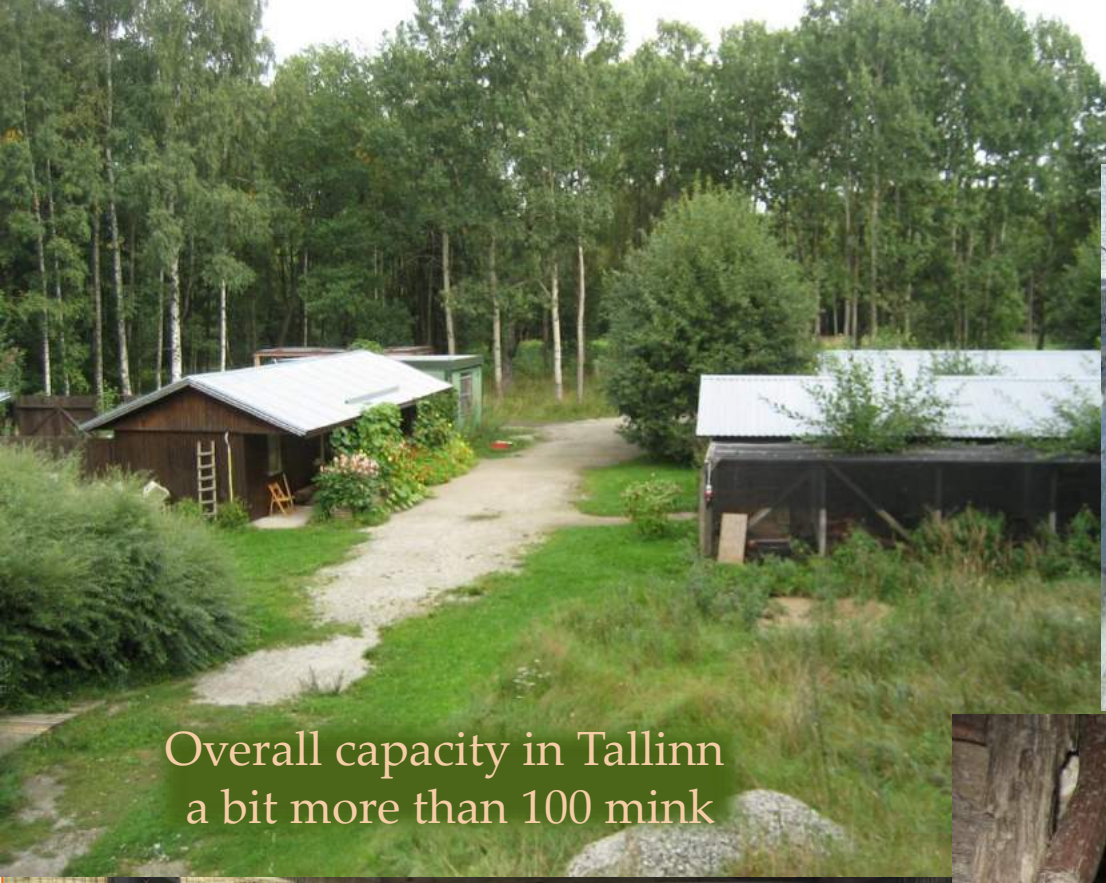
- Generation Length; 2,2
- Maximum potential lambda; 1,3089
- Current N; 222
- Current Ne; 75,0
- Ne/N; 0,34
- Current Gene Diversity; 0,9314
- Maximum N; **400**
- No founders added
- **You can exceed goals and maintain 85,6%**
- **You can maintain over 85,0% for up to 54 years**

Few insights to *ex situ* management

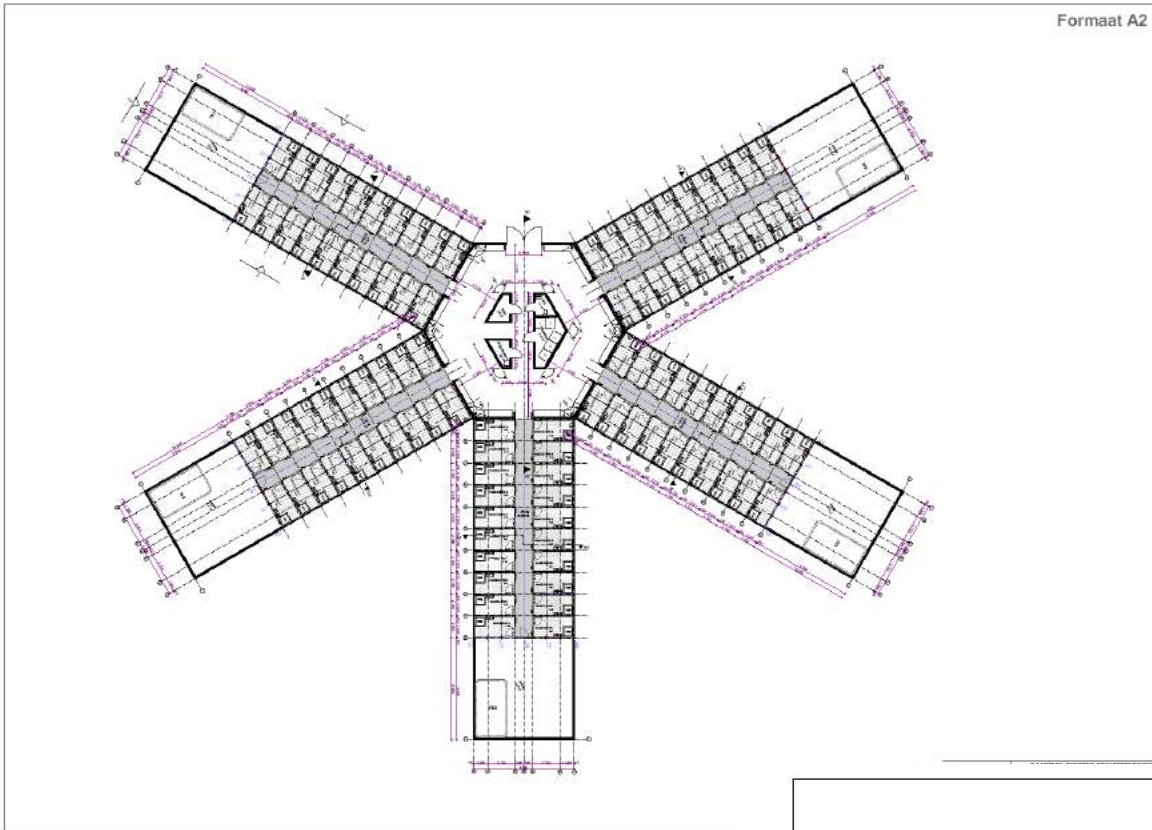
Estonia and France

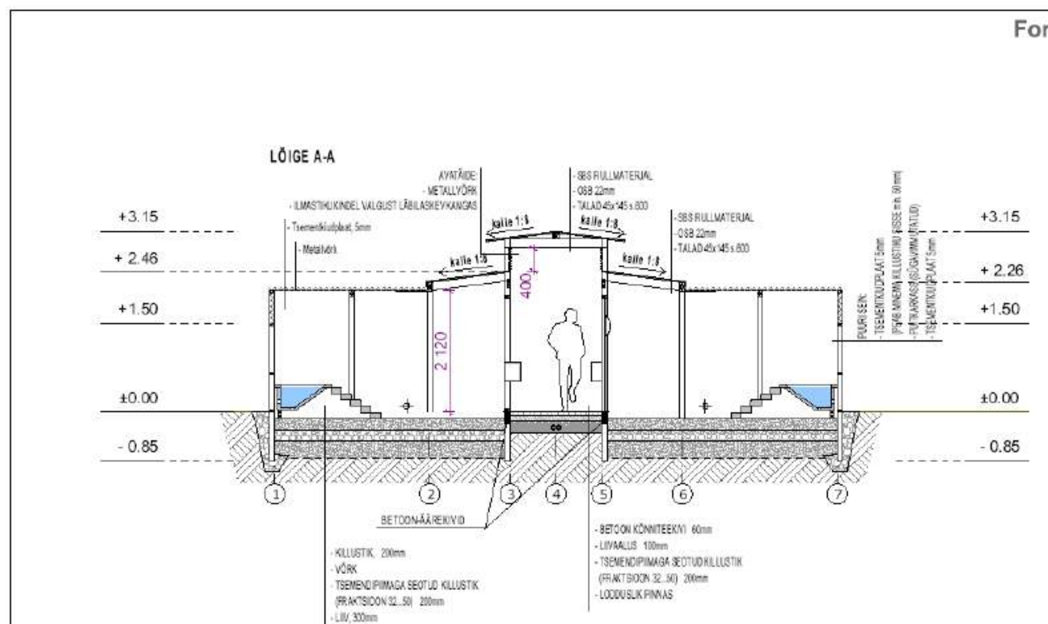
ESTONIA: The story dates back to 1980s





Overall capacity in Tallinn
a bit more than 100 mink


Formaat A2


LÕIGE A-A
AVATÄIDE:
- METALLVÕRK
- ILMASTIKUKINDEL VALGUST LÄBILASKEV KANGAS
- Tsementkiudplaat, 5mm
- Metallvõrk
- SBS RULLMATERJAL
- OSB 22mm
- TALAD 45x145 s.600
- SBS RULLMATERJAL
- OSB 22mm
- TALAD 45x145 s.600
kalle 1:8
kalle 1:8
kalle 1:8
kalle 1:8
400
2 120
+3.15
+ 2.46
+1.50
±0.00
- 0.85
+3.15
+ 2.26
+1.50
±0.00
- 0.85
1
2
3
4
5
6
7
BETOONÄÄREKIVID
- KILLUSTIK, 200mm
- VÕRK
- TSEMENDIPIIMAGA SEOTUD KILLUSTIK
(FRAKTSIOON 32...50) 200mm
- LIIV, 300mm
- BETOON KÕNNITEEKIVI 60mm
- LIIVAALUS 100mm
- TSEMENDIPIIMAGA SEOTUD KILLUSTIK
(FRAKTSIOON 32...50) 200mm
- LOODUSLIK PINNAS
For

Problems areas in EEP

Problem-areas in conservation breeding of European mink

- **Male problem- hyper-aggressive/passive males**
- **Not enough space (445 animal-spaces needed – only around 200 - 250 available.**
- **Genetic features of French-Spanish and Eastern European populations**
- *What to do with „unneeded“ surplus mink?*

Age class		Belarus	NW Russia	Captive population
0-1		30%	36,6%	18,1%
1-3		48%	30,8%	30,8%
3-4		12%	17,2%	17,2%
4<	4-7	10%	15,4%	23,8%
	7-9			7,9%
	9-11			2,2%

Male issue

- Most of the males tend to be abnormally aggressive or passive
- Only some 20 -30% of males are mating normally mate (1998 – 2009)
- Cause – unknown:
  - not hormonal, not a sperm quality, not enclosure size etc
  - Have something to do with management
  - Possibly multiple factors behind this

- Two males re-trapped in Hiiumaa in 2004 were not able to mate – the effect of "stress irreversible" ???

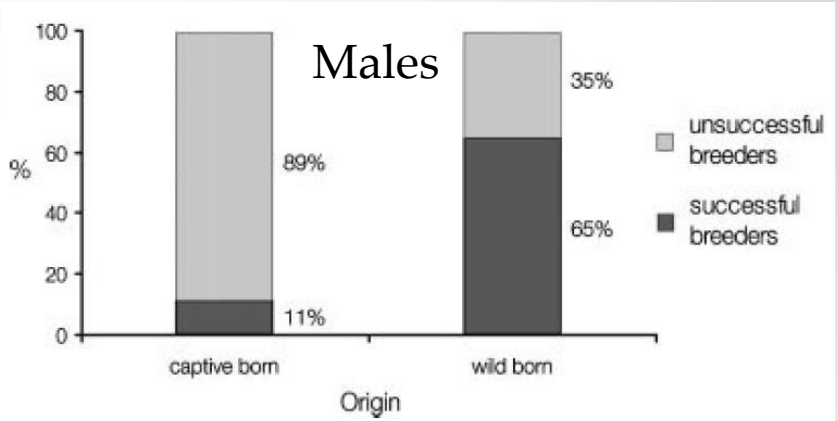
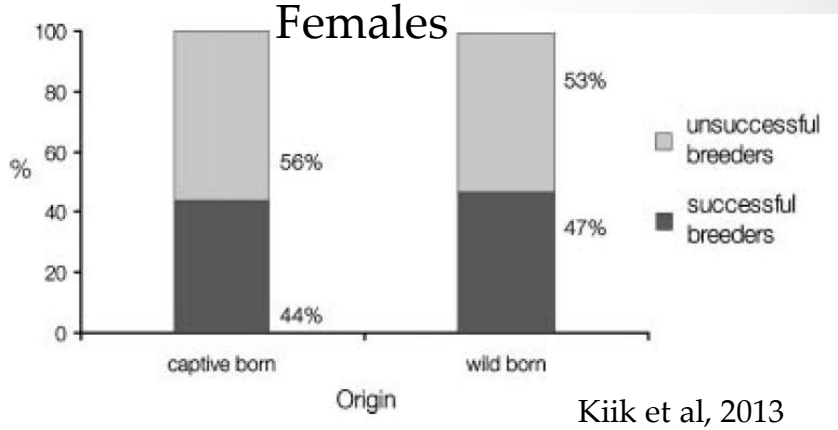


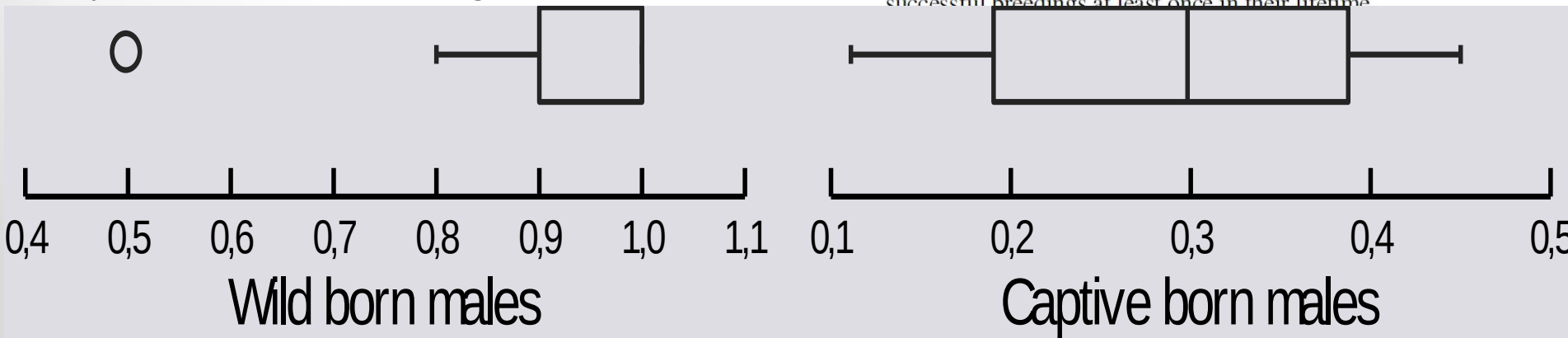
Fig. 1. Wild and captive born male European minks with successful breedings at least once in their lifetime.



Kiik et al, 2013

Fig. 2. Wild and captive born female European minks with successful breedings at least once in their lifetime

Yearly variation in breeding success



Implications of the male issue

Cabria et al, unpublished

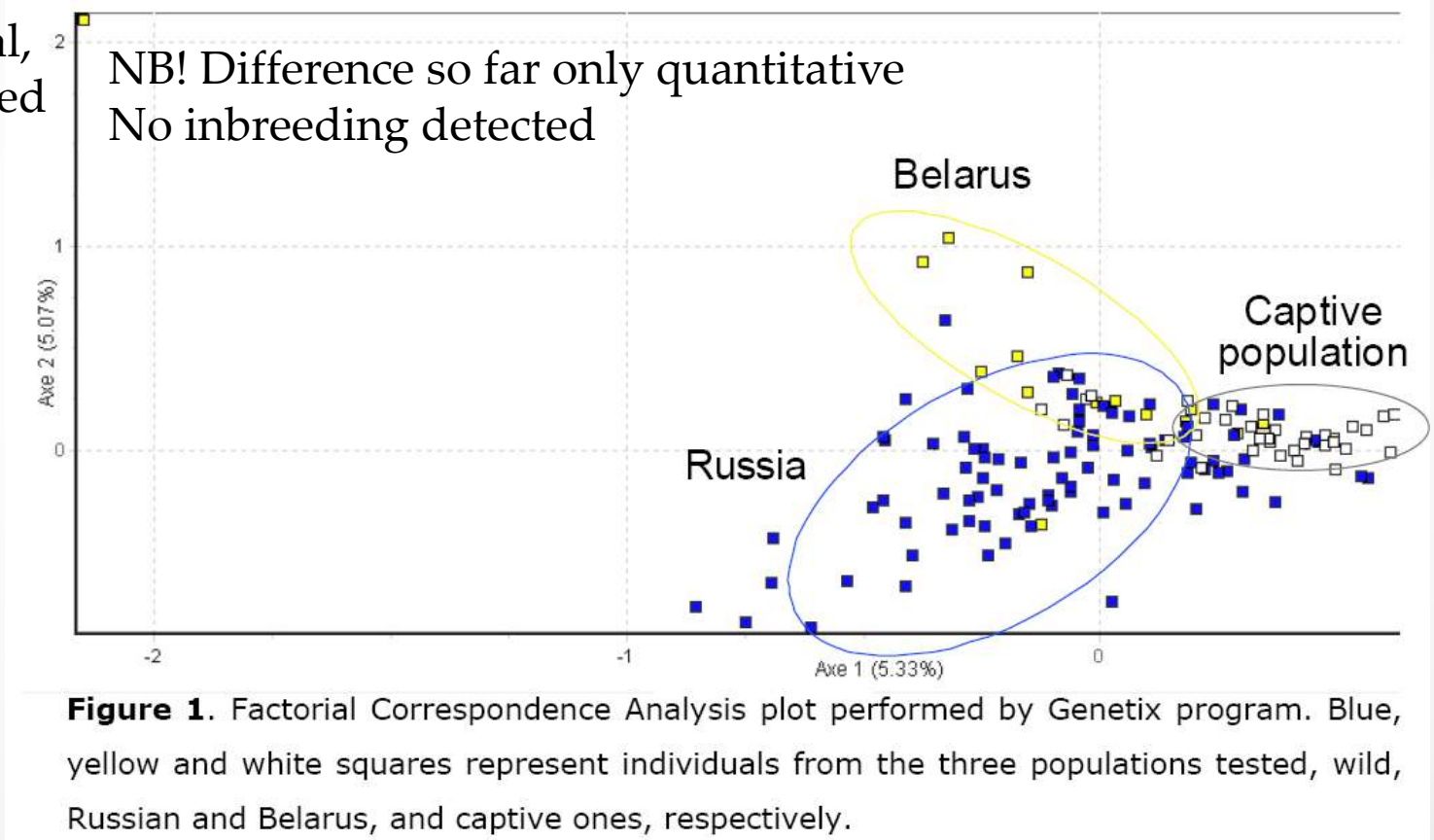
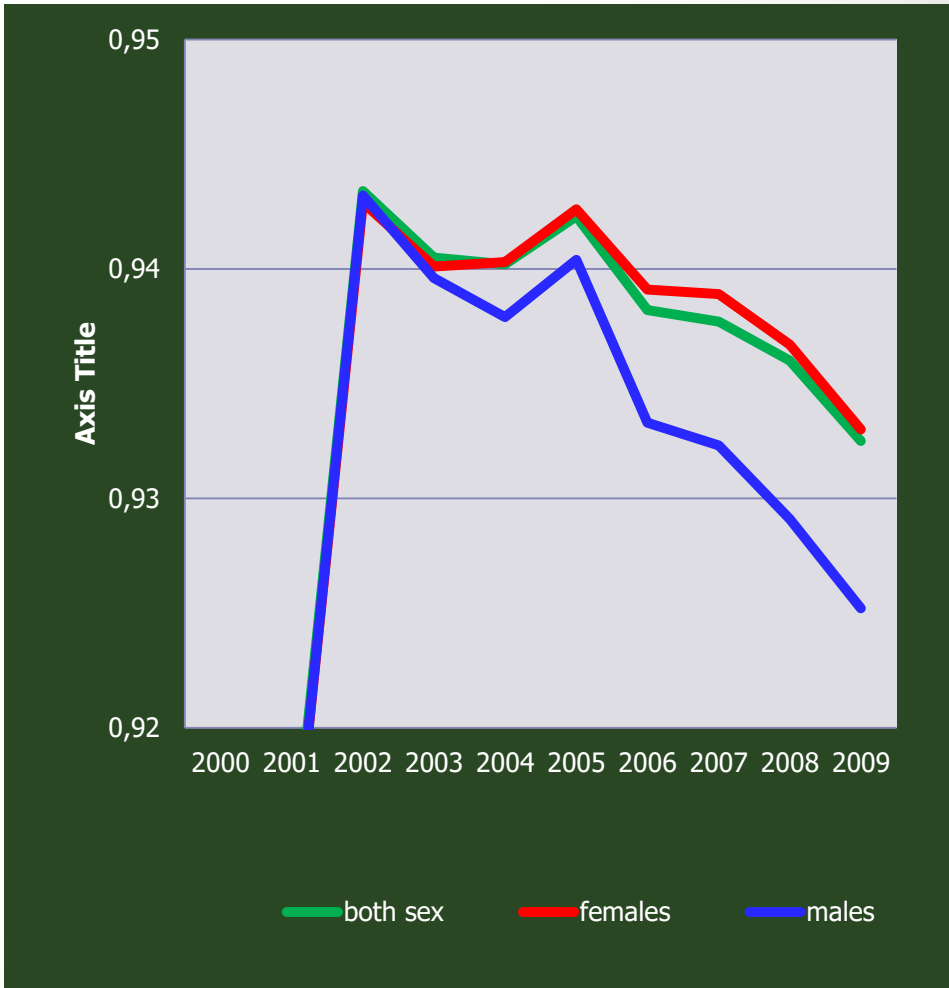


Figure 1. Factorial Correspondence Analysis plot performed by Genetix program. Blue, yellow and white squares represent individuals from the three populations tested, wild, Russian and Belarus, and captive ones, respectively.

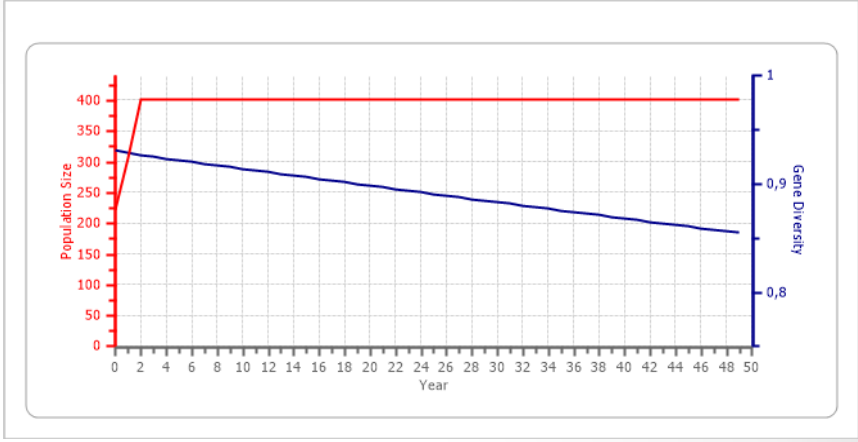
CAPTIVE POPULATIONS DIFFERENTIATES FROM WILD SOURCE POPULATION - WHY?

Inbreeding coefficients of males and females in Tallinn population

Gene diversity of males and females in Tallinn population



Insufficient space



To Retain 85,00 of the Gene Diversity at the end of 50 years

Population Variables:

Generation Length; 2,2
Maximum potential lambda; 1,3089
Current N; 222
Current Ne; 75,0
Ne/N; 0,34
Current Gene Diversity; 0,9314
Maximum N; **400**
No founders added
You can exceed goals and maintain 85,6%
You can maintain over 85,0% for up to 54 years

Solution: One program for Europe

Currently available space:

EEP programm 200 – 230
+ Zoodyssee 65
+ Spain 65 (?)

= Total 360
!!!! Still missing some 40 spaces

EAZA EU Life project to prepare all-European master plan and to increase interest in zoo community: 2016 - 2017.

Wild mink genetics Cabria, 2015

Table 2 Genetic variability estimates for eleven microsatellite loci tested in the European mink datasets I[a] and II[b]. The variable provided are: number of individuals tested (n), number of total alleles (N_A), the total private allele (P_A) with the corresponding percentage in brackets, allelic diversity (A), observed and expected heterozygosities, H_O and H_E respectively, and mean F_{IS} (Wright's statistic)

Sampling sites	n	N_A	P_A (%)	A	H_O	H_E	F_{IS}
All individuals tested	313	64	—	5.818	0.430 ± 0.113	0.578 ± 0.148	0.255
Microsatellite dataset I							
East (North and South)	151	61	32 (52.46 %)	5.546	0.532 ± 0.150	0.618 ± 0.156	0.141
Northeast	107	59	20 (33.90 %)	5.364	0.559 ± 0.153	0.613 ± 0.164	0.089
Russia	88	57	13 (22.81 %)	5.182	0.569 ± 0.151	0.619 ± 0.159	0.082
Belarus + Estonia	19	42	2 (4.76 %)	3.818	0.503 ± 0.230	0.54 ± 0.207	0.095
Southeast(Romania)	44	35	2 (5.71 %)	3.182	0.464 ± 0.170	0.496 ± 0.139	0.065
West	162	32	3 (9.38 %)	2.909	0.336 ± 0.161	0.439 ± 0.201	0.236
France	73	29	1 (3.45 %)	2.636	0.389 ± 0.182	0.430 ± 0.206	0.095
Spain	89	29	1 (3.45 %)	2.636	0.291 ± 0.184	0.353 ± 0.215	0.178
Microsatellite dataset II							
North Dvina	40	54					
West Dvina	28	47					
Volga	39	51					
Charentes	9	25					
Garonne	44	33					
Adour	23	26					
Cantabrian rivers	16	25					
Ebro	73	29	—	2.636	0.285 ± 0.183	0.337 ± 0.210	0.155

[a]Because of the low number of samples from Estonia, this locality was analyzed in combination with individuals from Belarus
[b]Results for the Danube river correspond to those obtained for the southeastern region

Solutions:

Lab genetic study

Or

Using hypotetical layer in analyses with decreased gene diversity for western animals

Or

Both

Learning points from European mink EEP management

Long-term commitment

Male issue CRITICAL

Collaborative management in Europe

Local solutions have to be found to the surplus issue

Always priority to *ex situ* in intensive management

Genetic issue between east and west

Translocations

Intensive management action

History of European mink translocations

IUCN Guidelines for Reintroductions and Other Conservation Translocations

August 2012

<u>Translocation</u>: the human-mediated movement of living organisms from one area with release in another,

Conservation translocations must have **<u>conservation benefit</u>** as **primary** objective

Key principles:

1. Ensure translocation is the best solution amongst alternatives,
2. **<u>Assess risk</u>**,
3. If substantial risk or uncertainty remains, don't translocate,
4. Monitor and manage adaptively.

RSG Reintroduction Specialist Group

ISSG Invasive Species Specialist Group

Translocation in Estonia

Since 2000

Getting rid of the American mink (1998-2000)

What is the aims in Estonia?

EX SITU ⟷ *IN SITU*

- Maintenance 85% of heterozygosity for 50 year
- Coordination: local program + EEP Programme

- Secure sanctuaries in the islands:

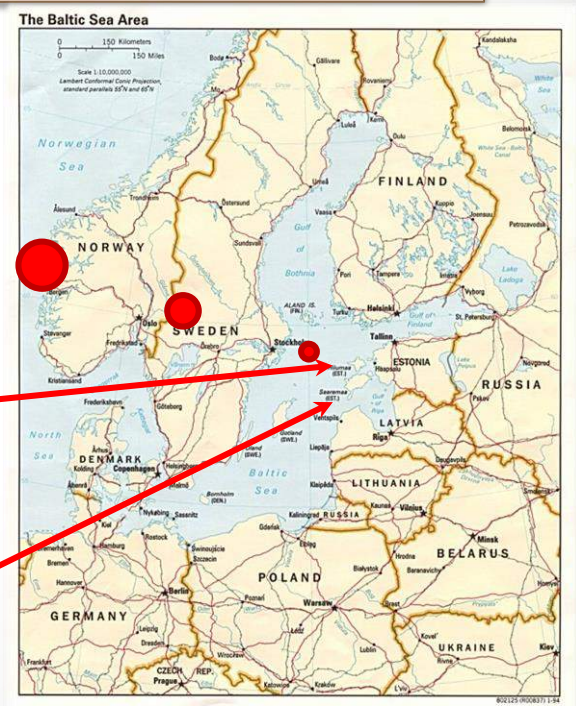
Introduction or re-introduction?

Hiiumaa (since 2000)

(~1000 km^2)

Saaremaa (trial in 2012)

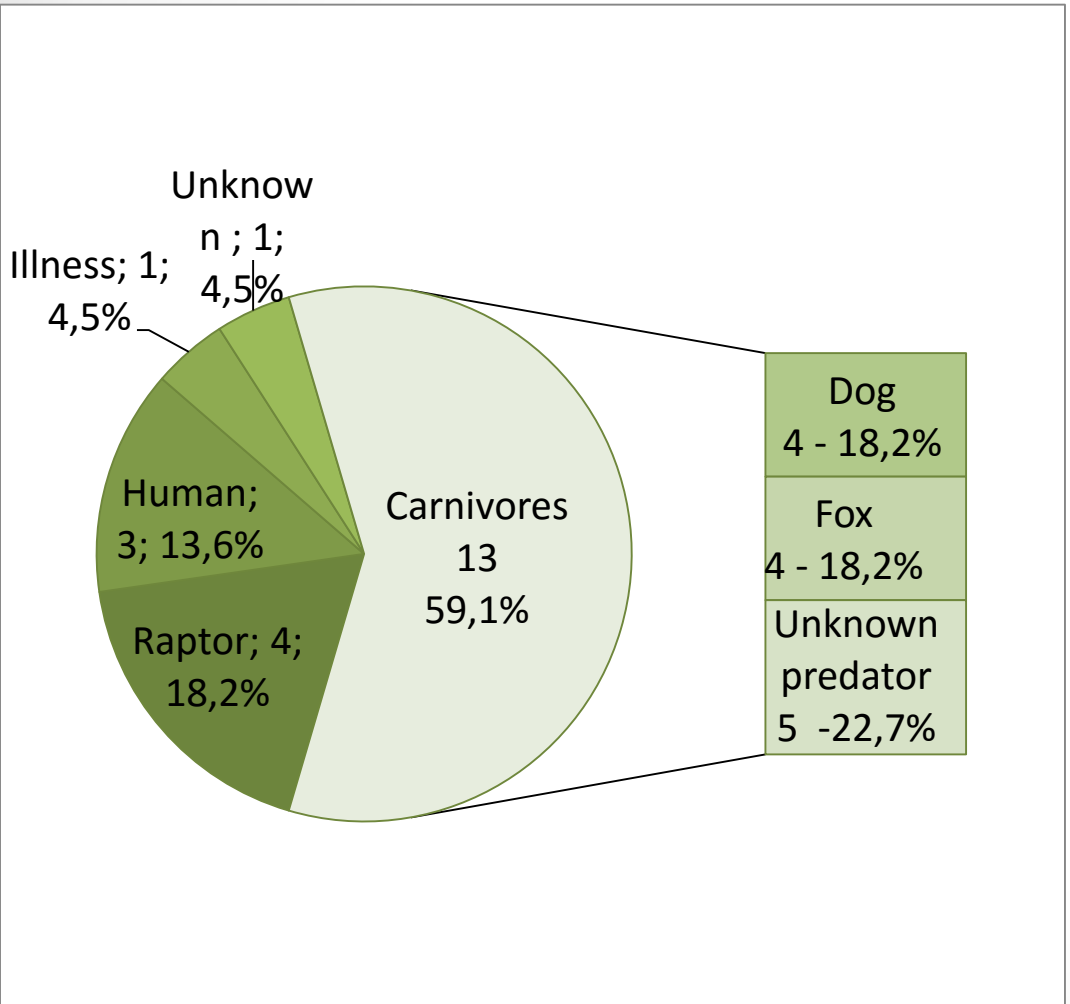
(~2400 km2)



! In 2000 tranlocation in both islands was aimed, Saaremaa was cancelled to remain focussed

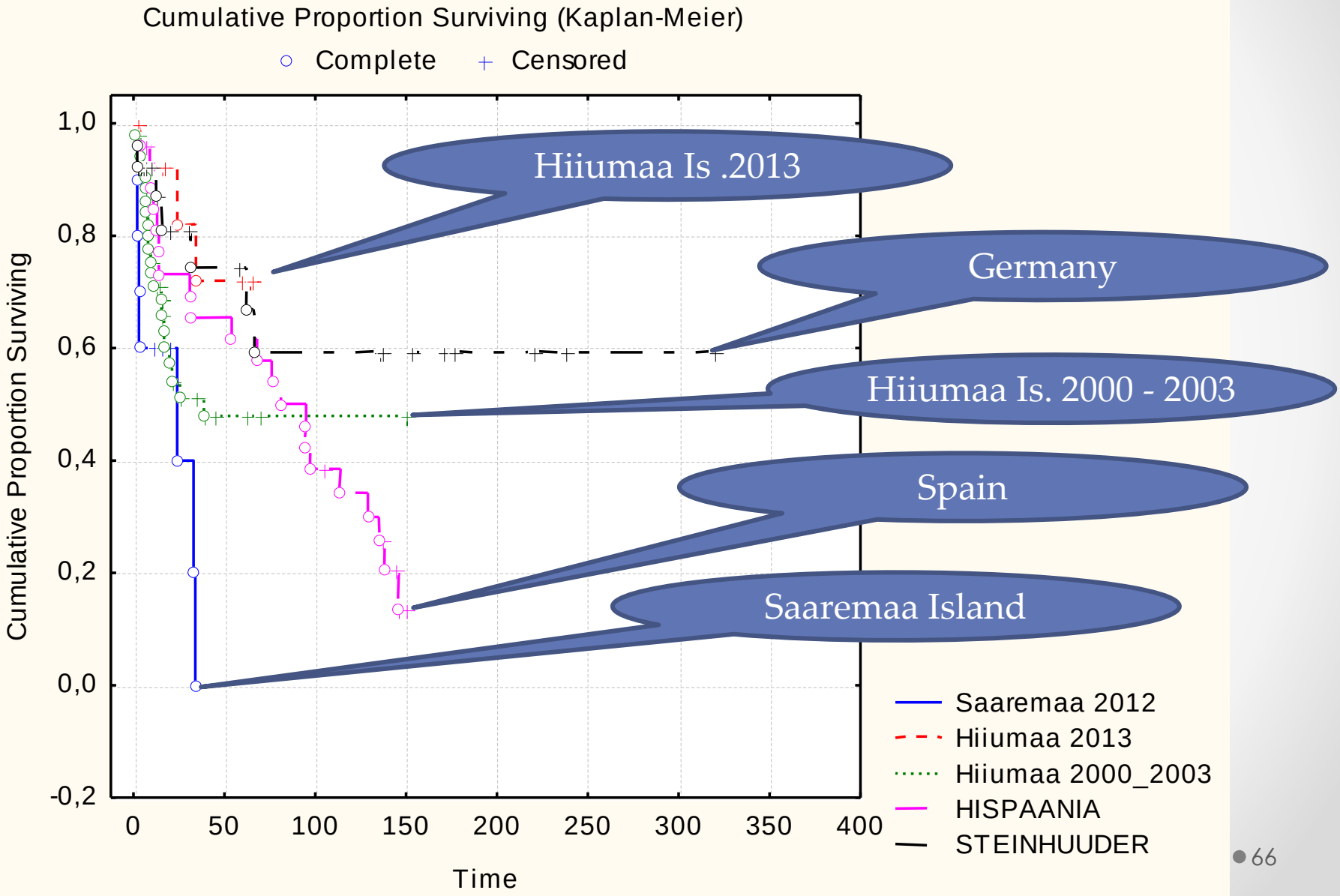
Mortality after release

Causes of death (N=22)

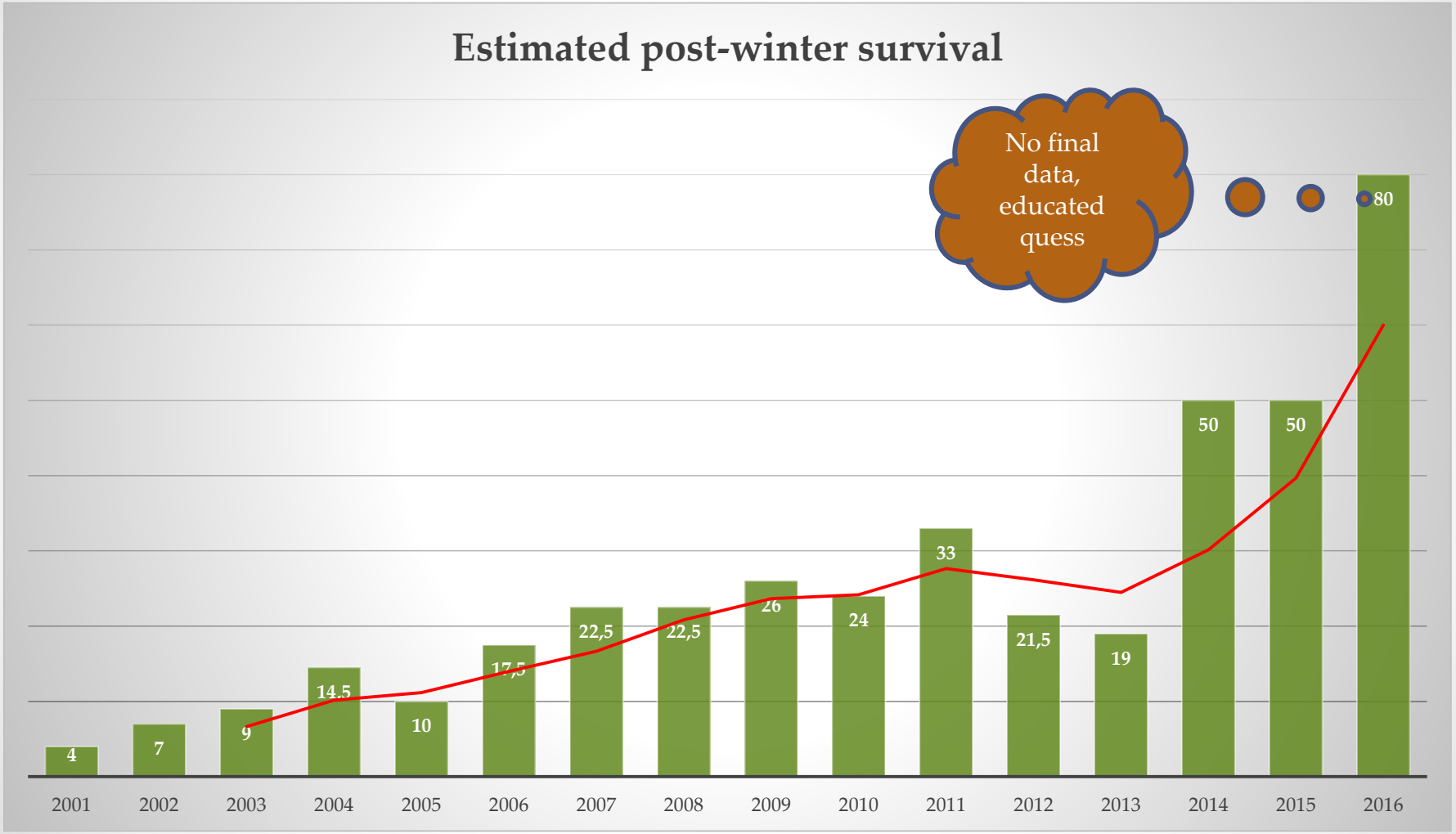


- Predators caused a large proportion (>75%) of all the recorded deaths.
- Although predators are the **proximate cause** of death, the **ultimate causes** may be a syndrome of mal-adaptations.

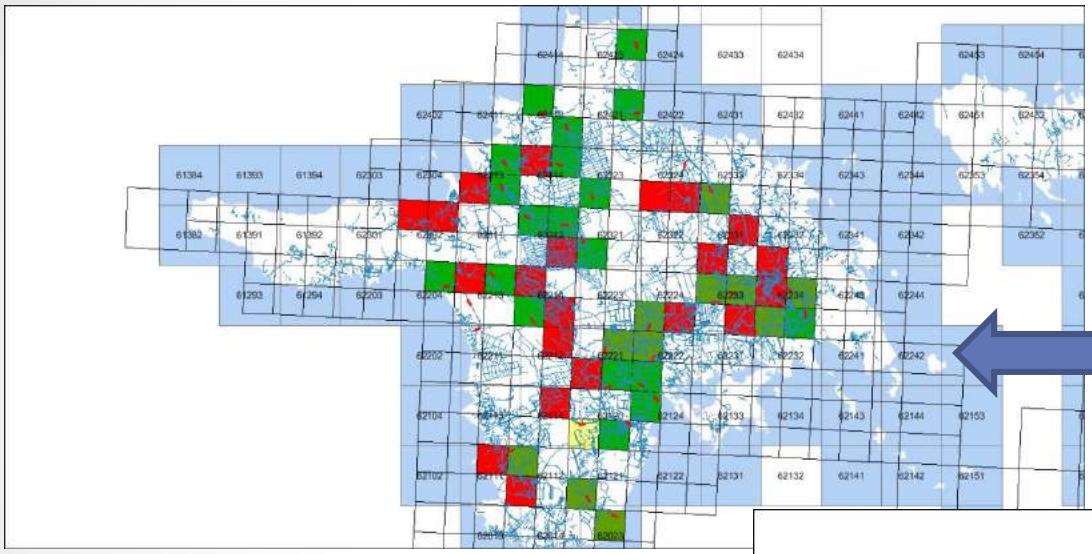
Adapation to the wild: five cases



Expected natural yearly mortality > 30%, mostly winter



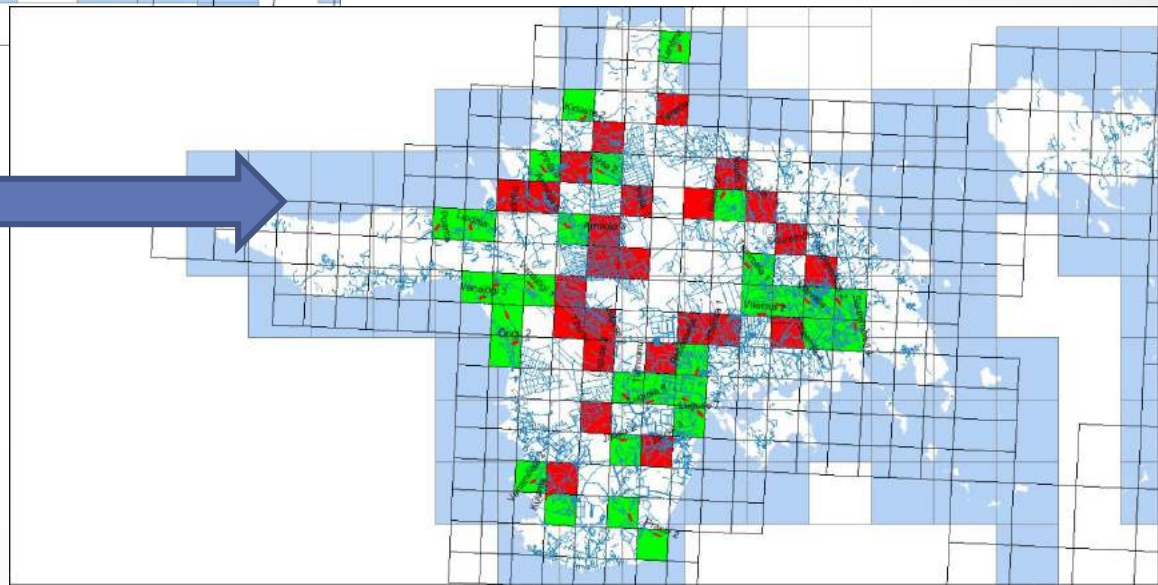
Status of Hiiumaa established population



2014:
Summer: 30 positive plots
21 negative plots

2015:

30 positive plots
25 negative plots



Status 2014 - 2016

2016 - **75 %** of lifetrapped mink - **wild-born**

Mink can be found basically **everywhere**:

- in very small streams,

- even in human settlements;

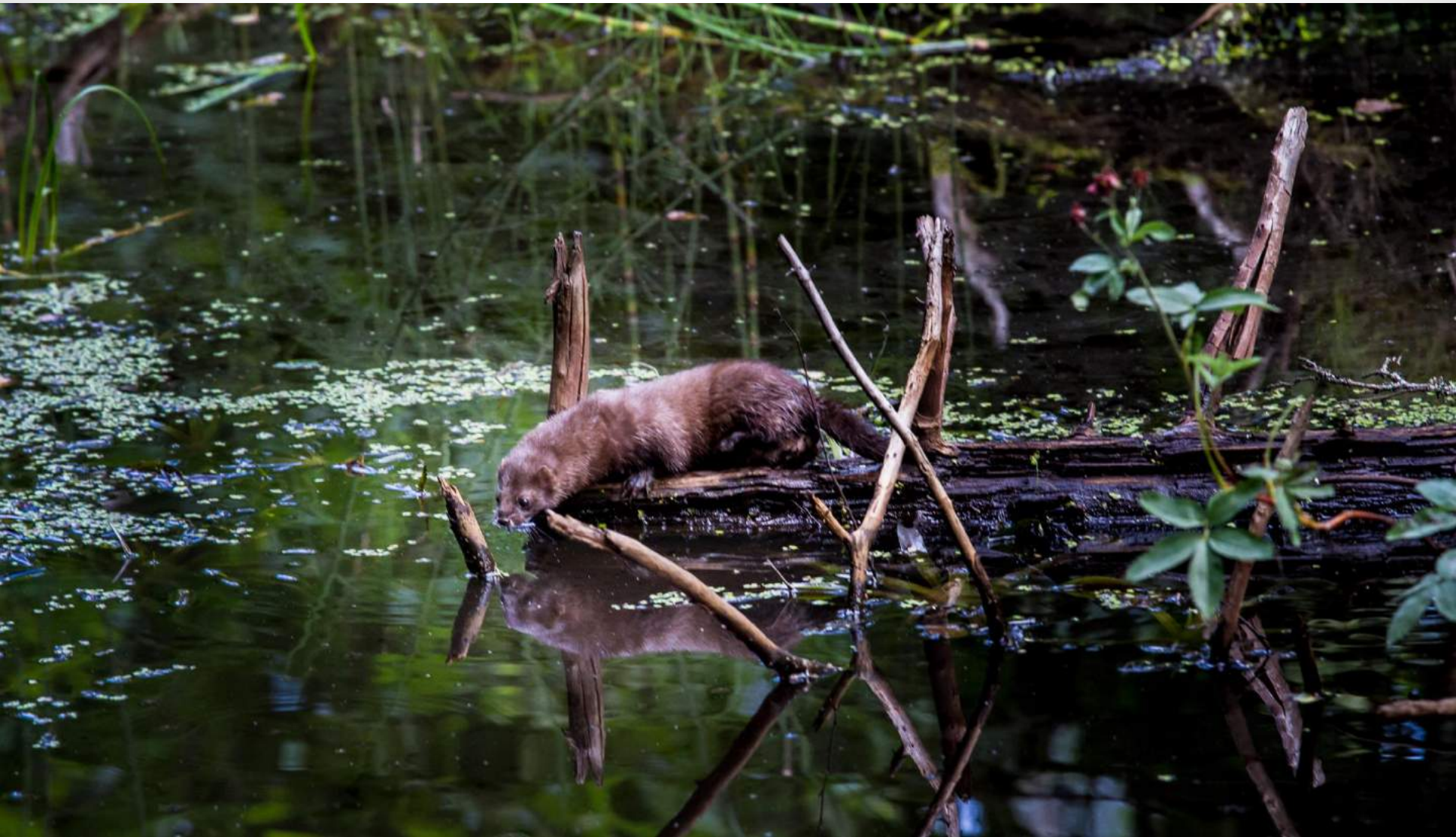
In 2014, mink have preyed on hens in farms

2014 ja 2015: number of mink surviving winter miinimum 40 – 60

2016: **winter-surviving** no of mink much higher – **80 ?**

Litter of wild mink in trailcamera

IT IS POSSIBLE!!
There is a wild population established in Hiiumaa Island




Think **out of box: Introduction? /re-introduction?/ risk assessments !**
„I know nothing except the fact of my ignorance“. Socrates
Be focussed, do less, but better
Keep people informed and … interested
Long-term commitment: planning, monitoring etc
Keep process simple and flexible
Do not give up with first strikebacks, learn from those

Challenge of knowing and of unknowing

„There are **known knowns**; there are things we know that we know.

There are **known unknowns**; that is to say, there are things that we now know we don't know.

But there are also **unknown unknowns** – there are things we do not know we don't know.“

… and there are **false knowns** !!!!!!

Photos: Tiit Maran, except:
Slide 35: A.Saveljev
Side 47: B&W – T. Talpsep
Slides 9-11: Ökologische Schutzstation Steinhuder Meer e.V
Slides 22 – 25 and 29 by J.D.Ballou