Wild mink as sentinels in environmental monitoring

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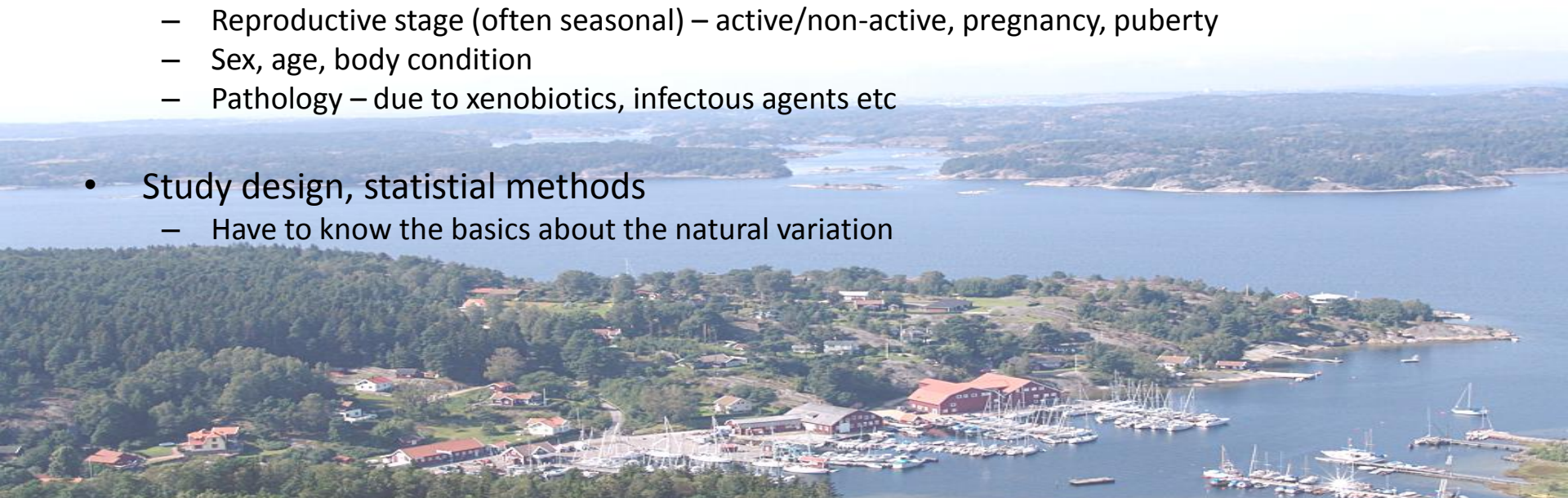
Chemicals in the environment – what happens?

- Exposure studies vs effect studies

- Large variation in data
- Exposure
  - Sex, age, diet, bofy condition, season, migration, habitat (point sources of pollution), year-year fluctuations, metabolism (hibernation, lactation etc)

- Physiological data, reproductive system
  - Normal individual variation
  - Reproductive stage (often seasonal) – active/non-active, pregnancy, puberty
  - Sex, age, body condition
  - Pathology – due to xenobiotics, infectous agents etc

- Study design, statistial methods
  - Have to know the basics about the natural variation



Sentinel species

- A tool for assessment of
  - the effects and/or exposure of environmental contamination
  - the impact on human and/or environmental health
- A biological early warning system

Mink (*Neovison vison*)

- The weasel family (*Mustelidae*)
- Brown, small white ventral spots
- Elongated body with small limbs
- 35-40 cm body
- About 0,5-1,2 kg

Way of life

- Opportunistic predator
  - Fish, crayfish, rodents, frogs, sea birds (and their eggs)
- Habitat close to water
  - Described as a distance along a shore-line
  - 1-2,5 km
  - Seldom more than 200 m from the shore

The mink as a sentinel

- High trophic status
- Semi-aquatic/piscivorous
- Restricted home range
- Well-known biology
- Maintained and studied in captivity
- Widespread distribution
- Captured in sufficient numbers
- Small – easy to handle and transport

Practicals

- Local hunters
  - Trapped or hunted (with dog and shotgun)
- Frozen by post
  - \+ Easier for hunters
  - \+ Better planning of necropsies
  - \+ Fewer rotten animals
  - – Histological quality
- 500+ mink collected
  - Approx 70% male mink
- 286 necropsies
  - Male and female
- Focus: reproductive organs

- Body measurements
- Subcutaneous fat
- Weight and/or size of reproductive organs
- Weight of internal organs
- Anogenital distance
- Sperm (needle aspiration)
- Tissues in fixative/freezer
- Blood

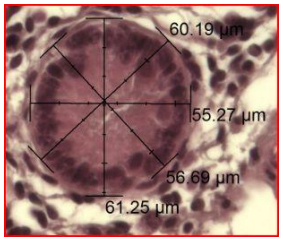
Whats the normal variation in reproductive traits?

- 115 male mink from all over Sweden
- Age categories: juvenile, one year old, two years and older
- August-April (autumn, winter and spring)

Necropsy data:

- Body and organ weights
- Nutritional status

- Diameter of seminiferous tubuli
- Sperm morphology



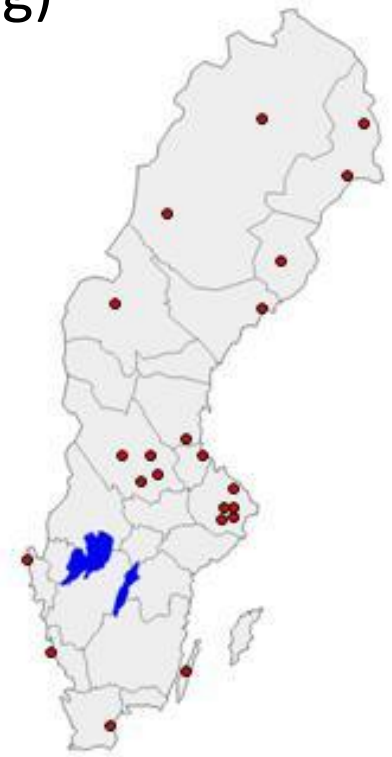


Table 1. Analysis of variance and data for reproductive traits, whole body measurements and some internal organ weights

Dependent variable	R^2 [a]	Source of variance (level of significance)			
		Age [b]	Nutritional status [b]	Season [b]	(Age x Season) [c]
Baculum length	53	<0.0001	0.05	0.002	n.s.[d]
Penis length	43	<0.0001	n.s.	0.008	n.s.
Penis weight	52	<0.0001	n.s.	0.001	n.s.
Testis weight	66	<0.0001	n.s.	<0.0001	0.0005
Epididymis weight	63	0.0002	n.s.	<0.0001	0.009
Tubuli diameter	71	<0.0001	n.s.	<0.0001	0.02
Tubuli diameter variation	41	0.03	n.s.	0.004	n.s.
Anogenital distance	29	<0.0001	0.03	n.s	n.s.
Body weight	30	n.s.	<0.0001	0.04	n.s.
Body length	18	n.s.	0.005	0.04	n.s.
Subcutaneous fat	88	n.s.	n.a.[e]	n.s.	n.s.
Spleen weight	20	n.s.	0.006	n.s.	n.s.
Liver weight	16	n.s.	n.s.	0.003	n.s.
Kidney weight	23	n.s	n.s.	0.003	n.s.
Adrenal weight	21	n.s.	n.s.	0.0009	0.01
Thyroid weight	8	n.s.	n.s.	n.s.	n.s.

[a] Coefficient of determination for the statistical model (%)

[b] The effect of age, nutritional status and season, respectively

[c] The interaction between the effects of age and season

[d] Not significant ($p<0.05$)

[e] Not applicable

Persson et al, Eur J Wildl Res, 2011

Table 3. Sperm morphology, defect sperm (%) *n=29*

	Mean ± SD	Range
Pathological heads[a]	5.5 ± 4.1	0.0-18.0
Mid-piece defects	2.1 ± 4.1	0-20.0
Tail defects[b]	0.9 ± 1.4	0-4.8
Detached sperm heads	8.4 ± 19.0	0-99.0
Proximal cytoplasmatic droplets	2.2 ± 3.0	0.0-13.0
Acrosome defects[c]	0.2 ± 0.4	0.0-1.6

[a] Pear-shaped, narrow-based, abnormal contour, lack of development, abnormal loose head, narrowness, variable size and abaxial implantation

[b] Simple coiled tail, tail coiled under the head and double coiled tail

[c] Knobbed, dented and protruded acrosome

Persson et al, Eur J Wildl Res, 2011

Exposure of environmental pollutants to wild mink

- 101 male mink

- PCBs
- Brominated flame retardants (BDEs)
- Pesticides

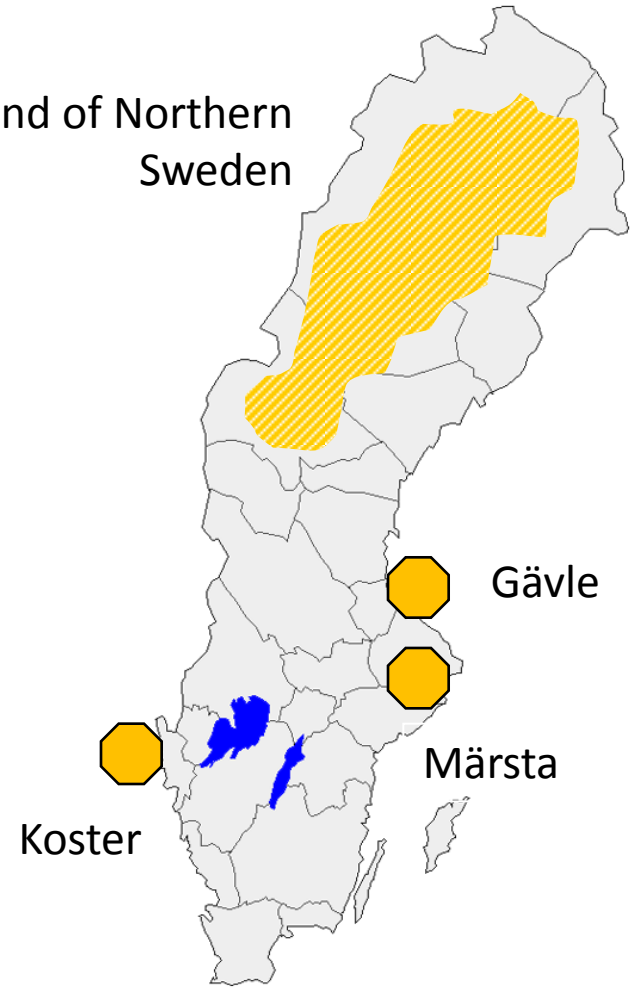
- Subcutaneous fat

- Which extrinsic and intrinsic factors influence the exposure?

Exposure of environmental pollutants to wild mink

Four areas:

1. Gävle Baltic Coast (G)
2. Koster Islands in Skagerrak (K)
3. Märsta inland (M)
4. The inland of Northern Sweden (N)



Natural variation

- Season is important
  - Reproductive seasonality
  - Important for some chemicals
- Age is important
  - Juveniles differs from adults in most reproductive aspects
  - Some traits differ beween 1 and 2 years and above
  - Important for some chemicals
- Nutritional status
  - Not important when assessing most reproductive traits and body measurements
  - Important for some chemicals

In summary

- Logistics and practicals works!

- Physiological variation
- Variation in exposure

- Important to take into account when looking for effects due to exposure to chemicals in the environment