On the genesis of trails in Nature

Modeling and monitoring visitor flow
MMV 3
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Introduction and context

Monitoring recreation…

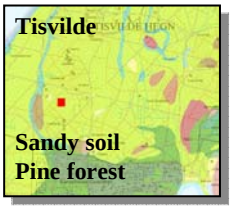
	Origin oriented	Destination oriented
Baseline structures	Urban type Urban greening	Nature type Facilities
Activities and behavior	Yearly frequency of visits	Year number of visitors
Effects and consequences	Physical activity Health	Trampling Litters

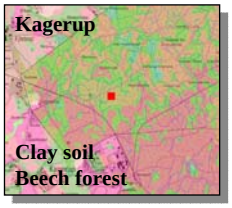
Agenda of the presentation

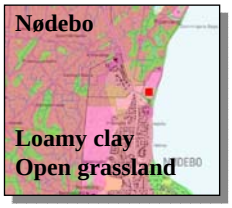
- **Location of sites**
- **Experimental design**
- **Selected questions to answer:**
  - **Soil compression vs. simple dept measurement**
  - **How do different recreational activities create trails**
  - **How do different environments respond to trampling**
  - **How do resistance and resilience mutually influence in the process of trail genesis**
- **Concluding remarks**

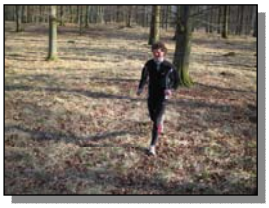
Locations

Annual weather (DK):
Presipitaion 721 mm
Temperature: 7.7° c









Method and experimental design

Skov & Landskab

At each location three sets of tracks were established:

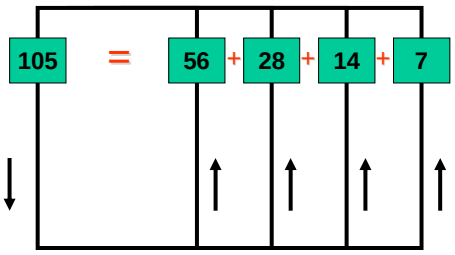
- **Walking**
- **Running**
- **Mountain biking**

Each set included 5 tracks:

- **7 crossings**
- **14 crossings**
- **28 crossings**
- **56 crossings**
- **105 crossings**

Trampling were repeated:

- **Every 2 weeks**
- **19 times from April to December 2005**



Registration of effects

Skov & Landskab

After each trampling the following parameters were recorded at a fixed point:

- **Track depth**
- **Track visibility (five classes)**
- **Track width**

A snapshot were taken at each track.

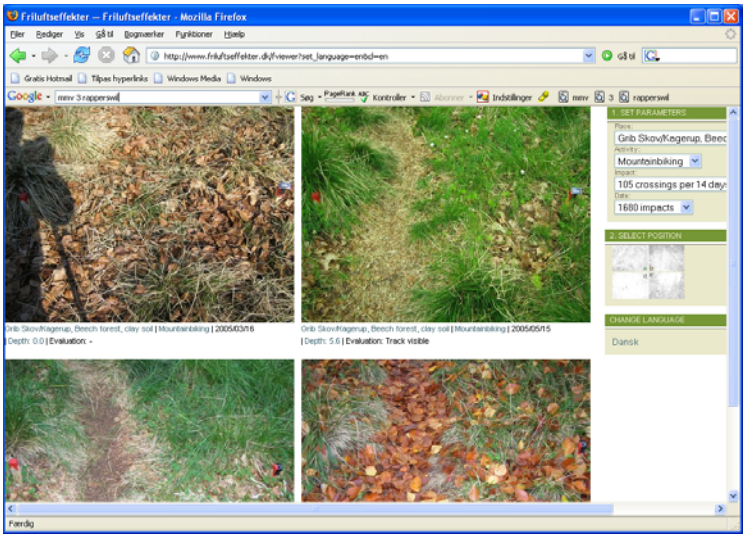
Once a month the soil dry density were measure in 10 and 30 cm depth (in triplicate).

After the trampling has stopped after the first year, registration continues every month.

Skov & Landskab

Image/registration viewer

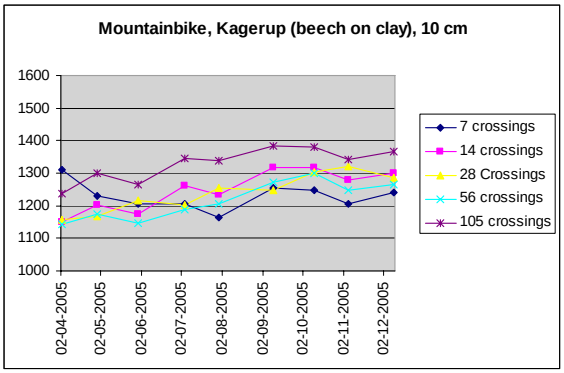
http://www.friluftseffekter.dk/fviewer

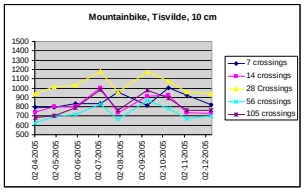


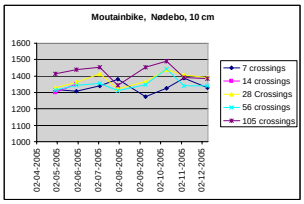
Skov & Landskab

Soil compression vs. simple depth measurement (I)

Dry density (gr/l)

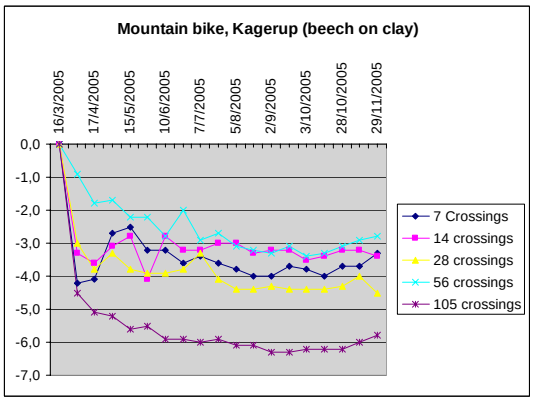


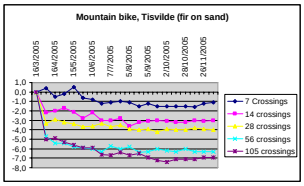


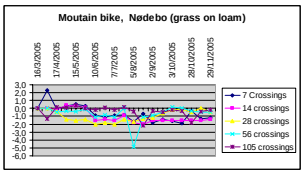


Soil compression vs. simple depth measurement (II)

Delta depth (cm)





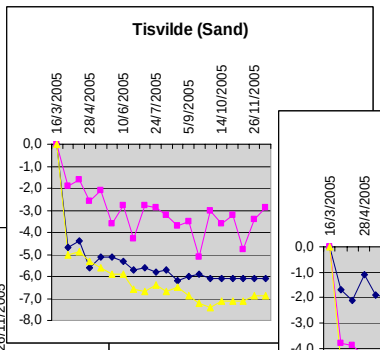


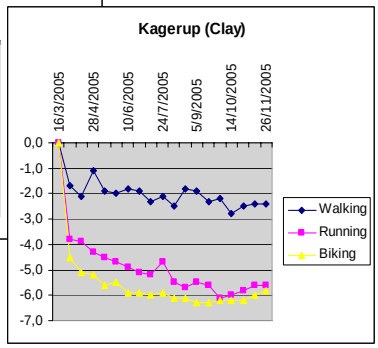
Conclusion: Don't bother to measure dry density

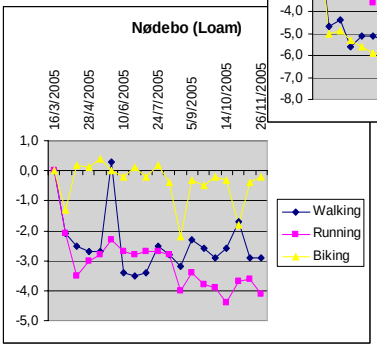
How do different recreational activities create trails (I)?

105 crossing per campaign as the maximum impact

Depth (cm)

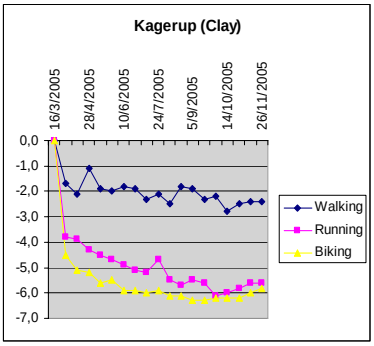


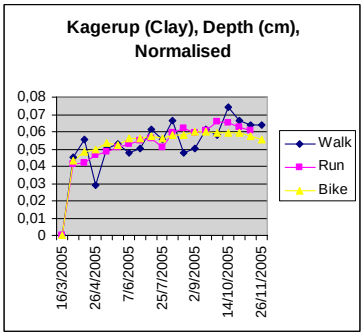




How do different recreational activities create trails (II)?

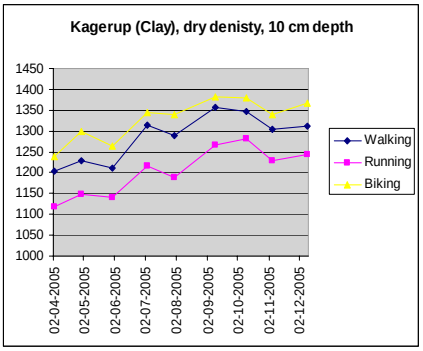
105 crossing per campaign as the maximum impact

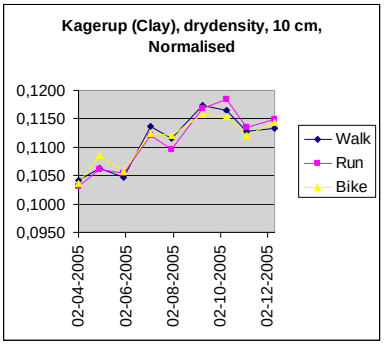




How do different recreational activities create trails (III)?

105 crossing per campaign as the maximum impact





Conclusion: Different activities has the same trampling effect

Effect of activities (IV):

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Example: Kagerup (Clay) Walk

0 crossings

630 crossings

1250 crossings

1890 crossings

Effects of activities (V):

Skov & Landskab

Example: Kagerup (Clay) Run

0 crossings

315 crossings

1250 crossings

1890 crossings

Image/registration viewer (VI):

Skov & Landskab

Example: Kagerup (Clay) Bike

0 crossings

630 crossings

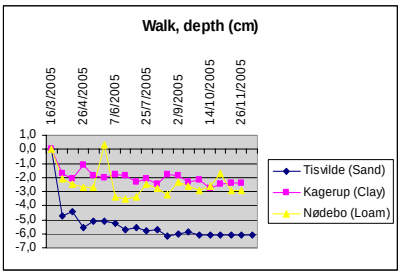
1250 crossings

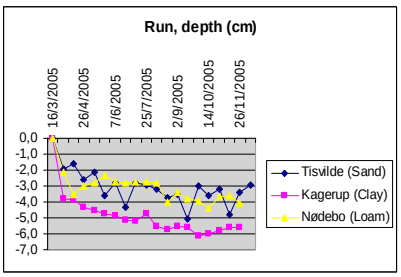
1890 crossings

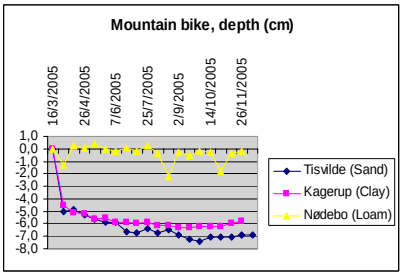
How do different environments respond to trampling

Skov & Landskab

105 crossings per campaign







Conclusion: There is no clear indication of different effects on different environments.

Resilience after trampling Tisvilde (Sand)

Mountain bike

December 2005

September 2006

Resilience after trampling Kagerup (Clay)

Mountain bike

December 2005

September 2006

Resilience after trampling Nødebo (Loam)

Mountain bike

December 2005

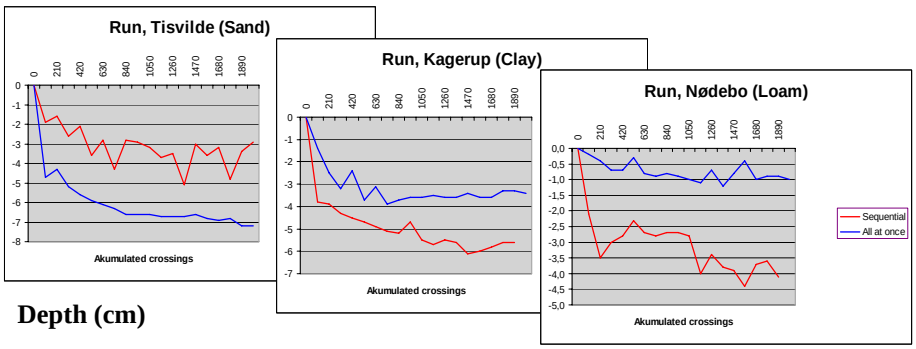
Conclusion: Recovery is faster on grassland, followed by clay land. The slowest recovery rate is on sand.

September 2006

On resistance and resilience

An additional trampling was set up repeating 20 x 105 crossings (only running) at the same day at each of the three locations.

Registration/photographing every 105 crossings (no soil compression measured).



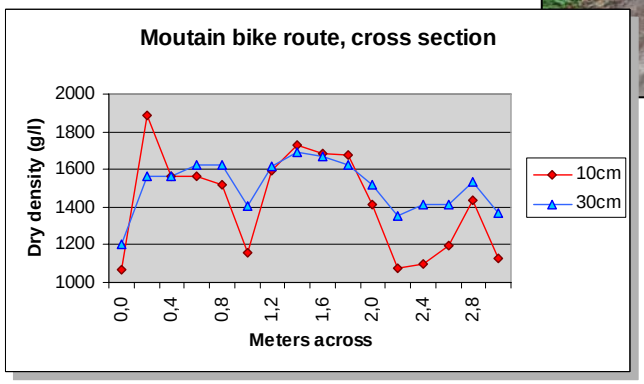
Depth (cm)

A 'Real world case':
Mountain biking I Rude Skov

Skov & Landskab

Measures were taken 20 cm apart across a mountain bike track

Annual load equals 10,000 bikers



Concluding remarks

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- **Trampling has an effect, but…**
- **Don't bother to measure dry density, but…**
- **Different activities has the same trampling effect, but…**
- **There is no clear indication of different effects on different environments, but…**
- **Recovery is faster on grassland, followed by clay land. The slowest recovery rate is on sand, but…**

That's all…

Thank you for your attention

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