



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





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Agenda of the presentation

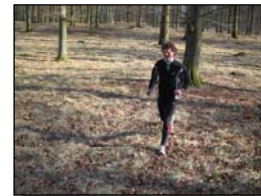
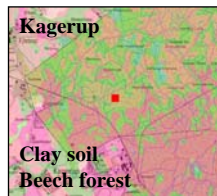
- Location of sites
- Experimental design
- Selected questions to answer:
 - Soil compression vs. simple dept measurement
 - How do different recreational activities create trails
 - How do different environments respond to trampling
 - How do resistance and resilience mutually influence in the process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



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Locations

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





Method and experimental design

At each location three sets of tracks were established:

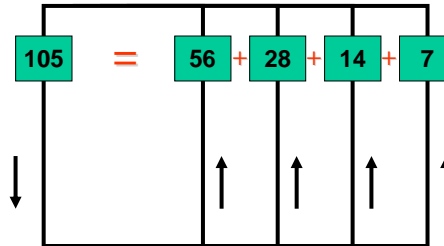
- Walking
- Running
- Mountain biking

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

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.

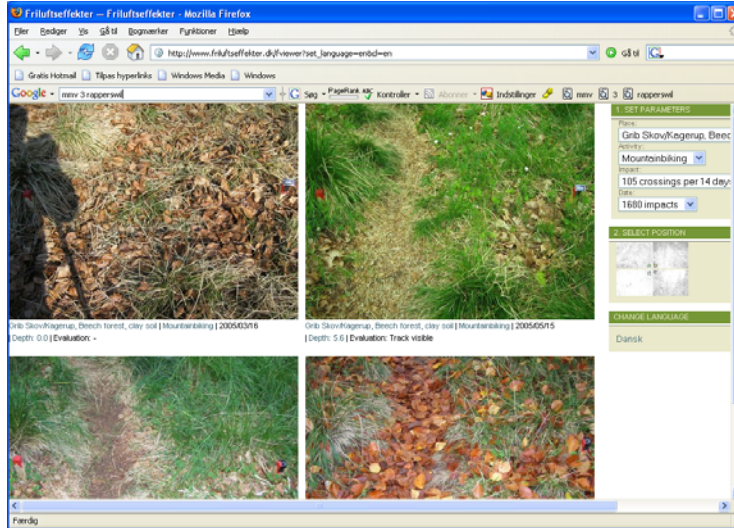
Once a month the soil dry density were measure in 10 and 30 cm depth (in triplicate).

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



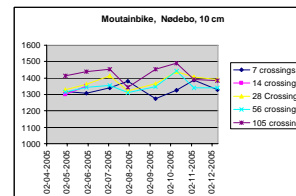
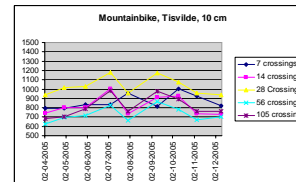
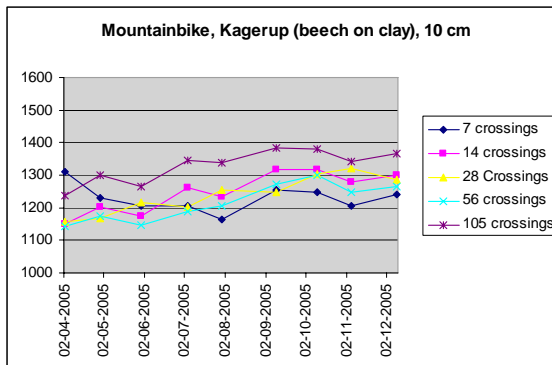
Image/registration viewer

<http://www.friluftseffekter.dk/fviewer>



Soil compression vs. simple depth measurement (I)

Dry density (gr/l)



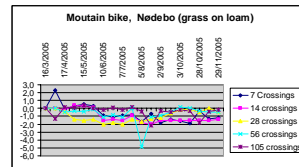
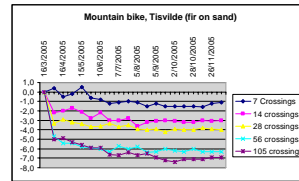
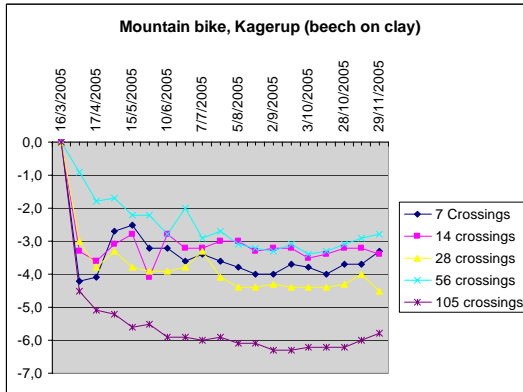


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Soil compression vs. simple depth measurement (II)



Delta depth (cm)



Conclusion: Don't bother to measure dry density

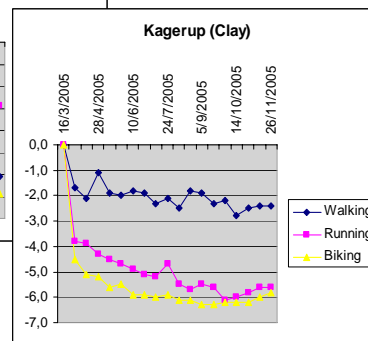
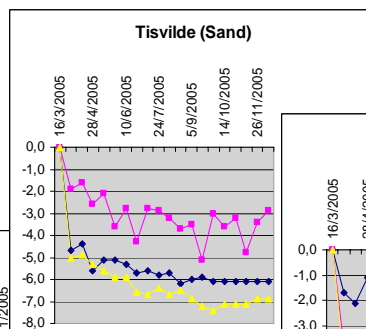
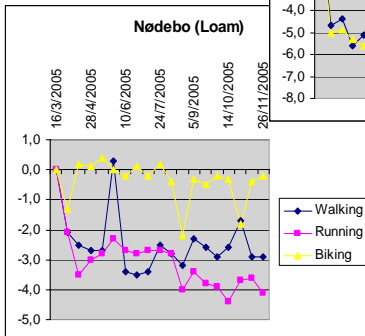


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How do different recreational activities create trails (I)?

105 crossing per campaign as the maximum impact

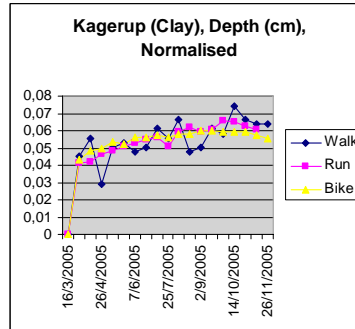
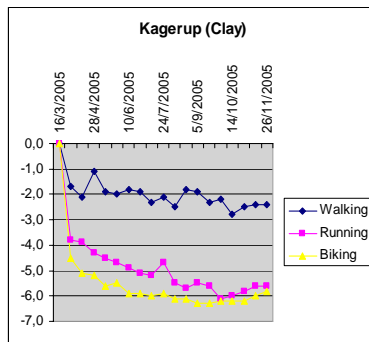
Depth (cm)





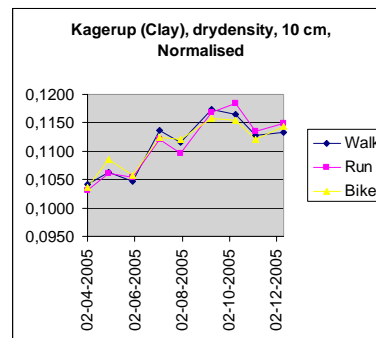
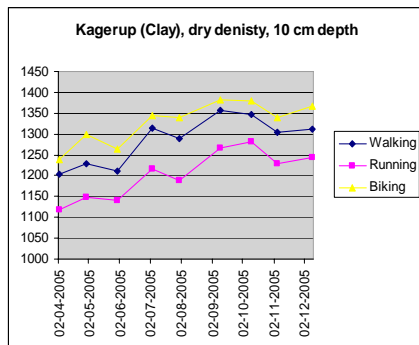
How do different recreational activities create trails (II)?

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



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Effect of activities (IV):

Example:
Kagerup
(Clay)
Walk



0 crossings



630 crossings



1250 crossings



1890 crossings



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Effects of activities (V):

Example:
Kagerup
(Clay)
Run



0 crossings



315 crossings



1250 crossings



1890 crossings



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Image/registration viewer (VI):

**Example:
Kagerup
(Clay)
Bike**



0 crossings



630 crossings



1250 crossings



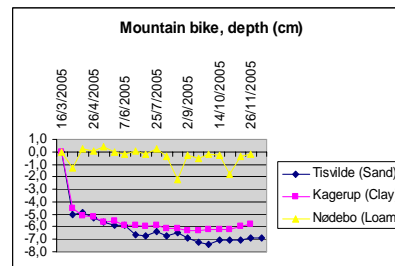
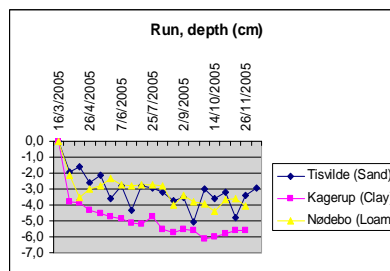
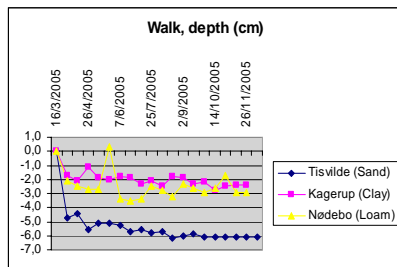
1890 crossings



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How do different environments respond to trampling

105 crossings per campaign



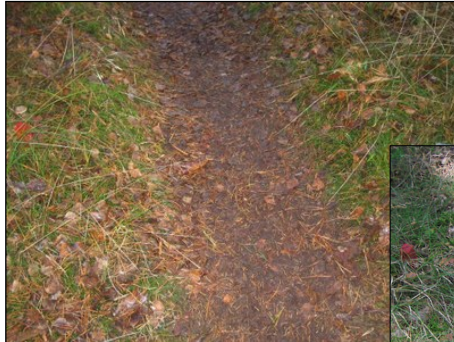
Conclusion: There is no clear indication of different effects on different environments.



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Resilience after trampling Tisvilde (Sand)

Mountain bike



December 2005



September 2006



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Resilience after trampling Kagerup (Clay)

Mountain bike



December 2005



September 2006



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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

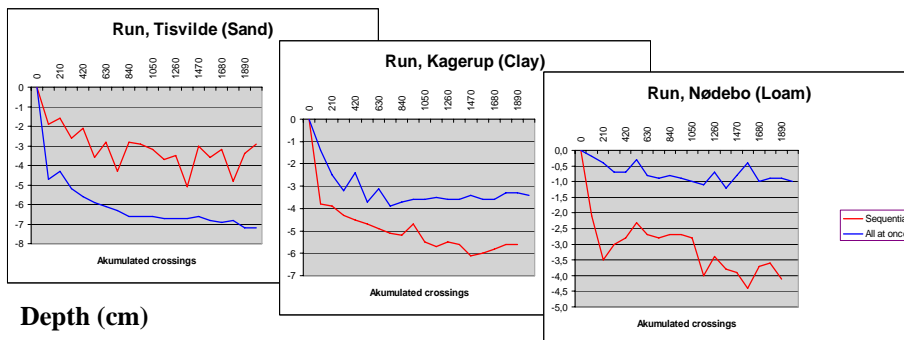


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On resistance and resilience

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)

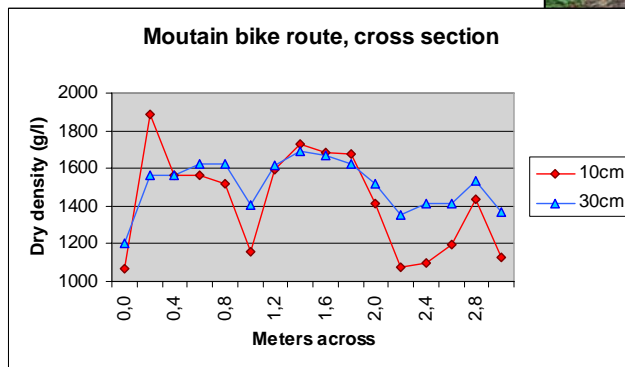


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A 'Real world case': Mountain biking I Rude Skov

Measures were taken 20 cm apart
across a mountain bike track

Annual load equals 10,000 bikers



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Concluding remarks

- **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...**





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That's all...



Thank you for your attention

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