



Skov & Landskab

On the genesis of trails in Nature

Modeling and monitoring visitor flow

MMV 3

September 13-15, 2006



Hans Skov-Petersen

hsp@kvl.dk

Danish centre for Forest, Landscape and Planning

+45 35 28 18 16



Skov & Landskab

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 |





Skov & Landskab

Agenda of the presentation

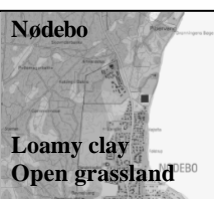
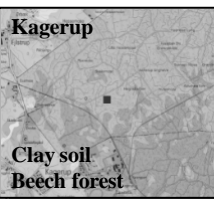
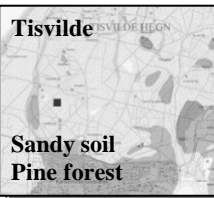
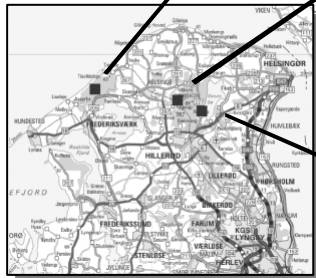
- Location of sites
- Experimental design
- Selected questions to answer:
 - Soil compression vs. simple dept measurement
 - How do different recreational activities create trails
 - How do different environments respond to trampling
 - How do resistance and resilience mutually influence in the process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



Skov & Landskab

Locations

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





Method and experimental design

At each location three sets of tracks were established:

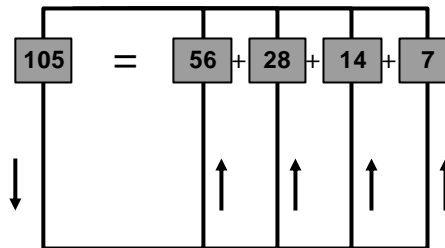
- Walking
- Running
- Mountain biking

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.

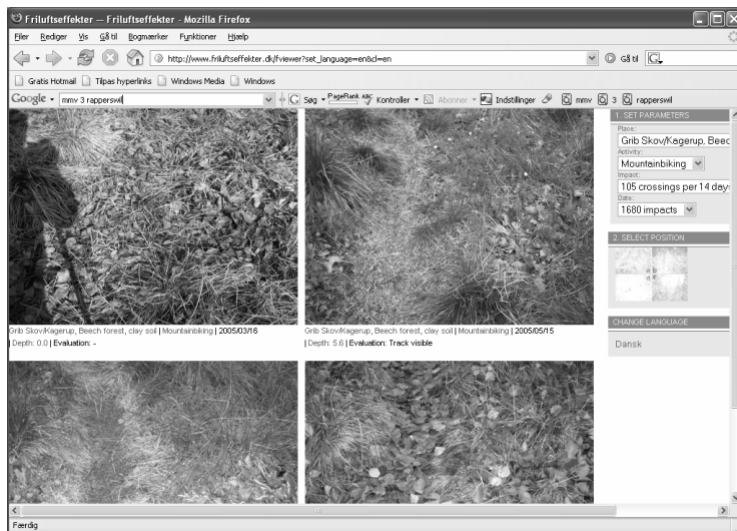
Once a month the soil dry density were measure in 10 and 30 cm depth (in triplicate).

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



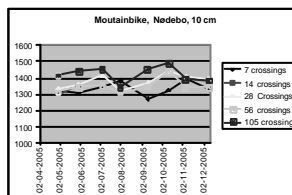
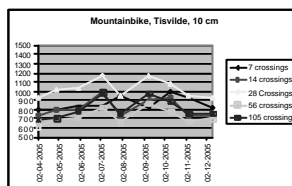
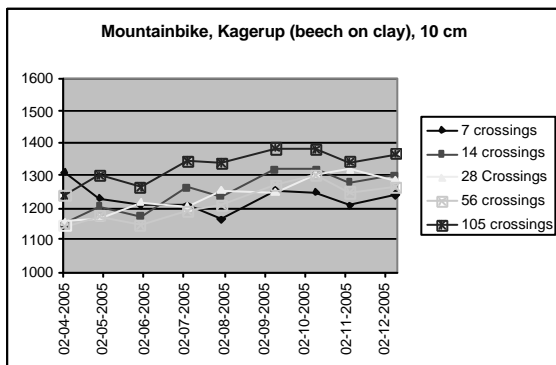
Image/registration viewer

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



Soil compression vs. simple depth measurement (I)

Dry density (gr/l)



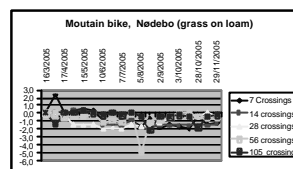
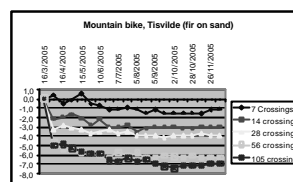
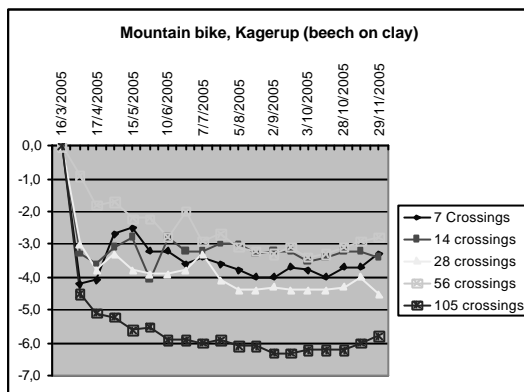


Skov & Landskab

Soil compression vs. simple depth measurement (II)



Delta depth (cm)



Conclusion: Don't bother to measure dry density

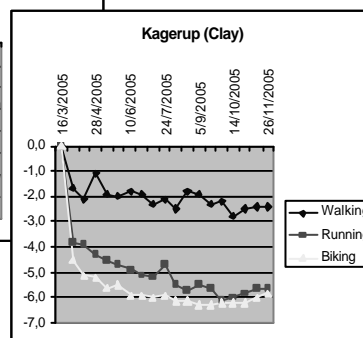
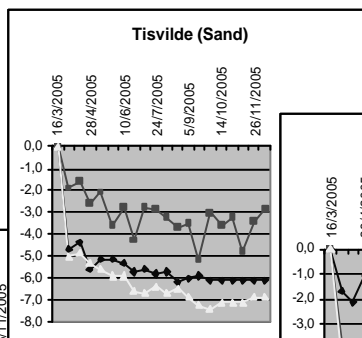
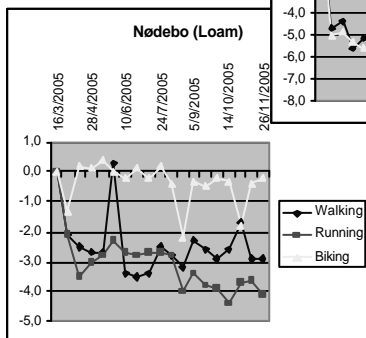


Skov & Landskab

How do different recreational activities create trails (I)?

105 crossing per
campaign as the
maximum impact

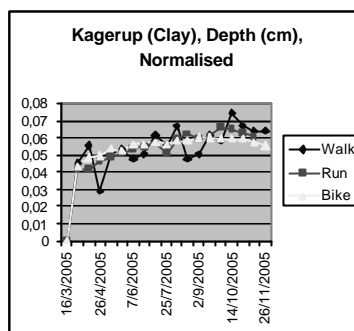
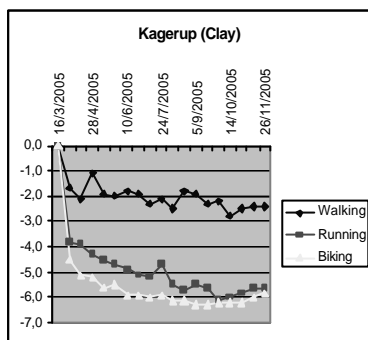
Depth (cm)





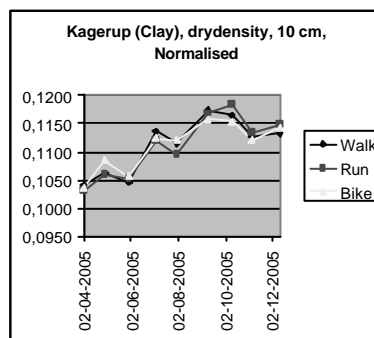
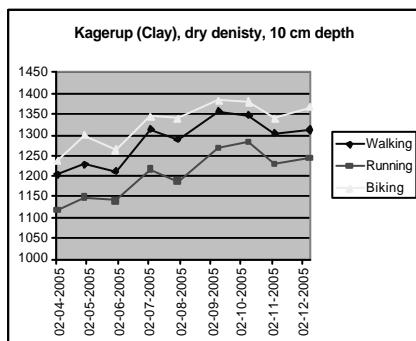
How do different recreational activities create trails (II)?

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



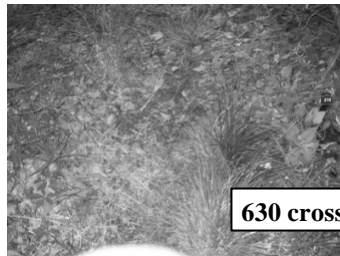
Skov & Landskab

Effect of activities (IV):

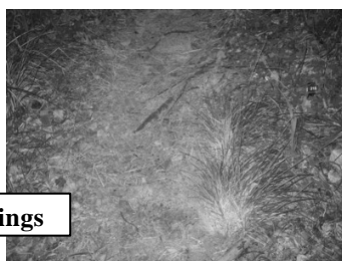
**Example:
Kagerup
(Clay)
Walk**



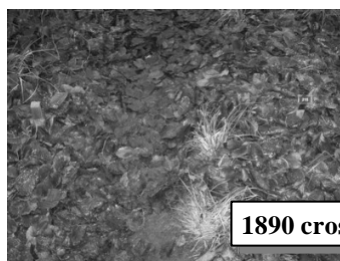
0 crossings



630 crossings



1250 crossings



1890 crossings



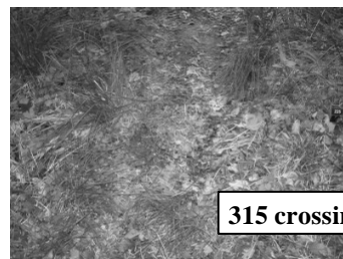
Skov & Landskab

Effects of activities (V):

**Example:
Kagerup
(Clay)
Run**



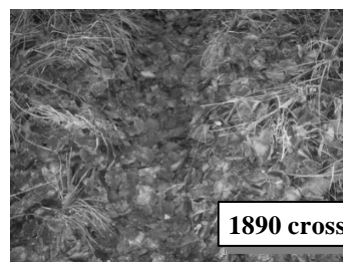
0 crossings



315 crossings



1250 crossings



1890 crossings



Skov & Landskab

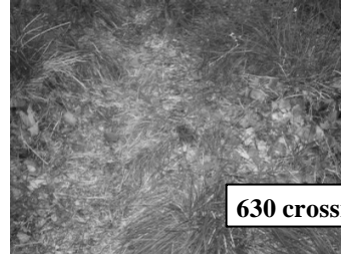
Image/registration viewer (VI):

**Example:
Kagerup
(Clay)
Bike**

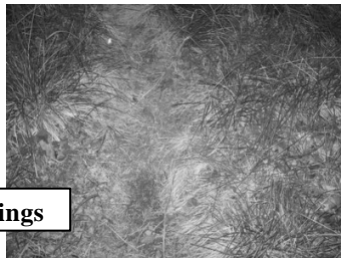
0 crossings



630 crossings



1250 crossings



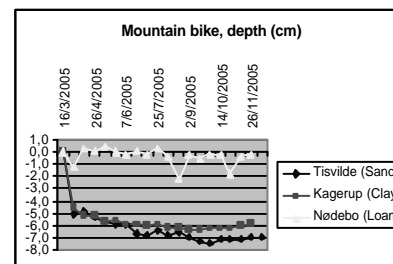
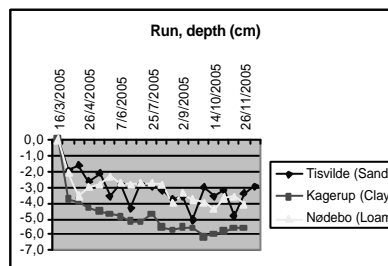
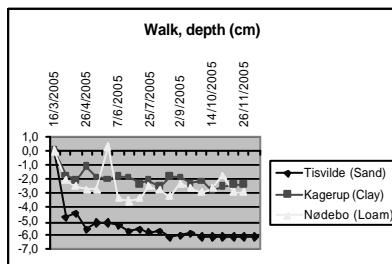
1890 crossings



Skov & Landskab

How do different environments respond to trampling

**105 crossings per
campaign**



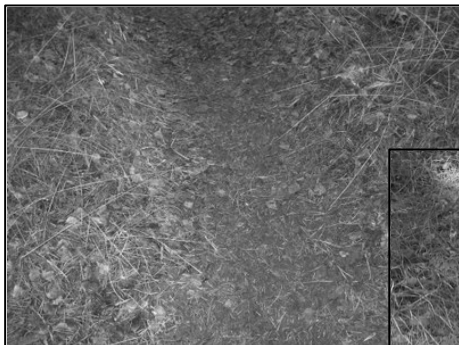
**Conclusion: There is no clear
indication of different effects on
different environments.**



Skov & Landskab

Resilience after trampling Tisvilde (Sand)

Mountain bike



December 2005



September 2006



Skov & Landskab

Resilience after trampling Kagerup (Clay)

Mountain bike



December 2005



September 2006



Resilience after trampling Nødebo (Loam)

Mountain bike

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



December 2005



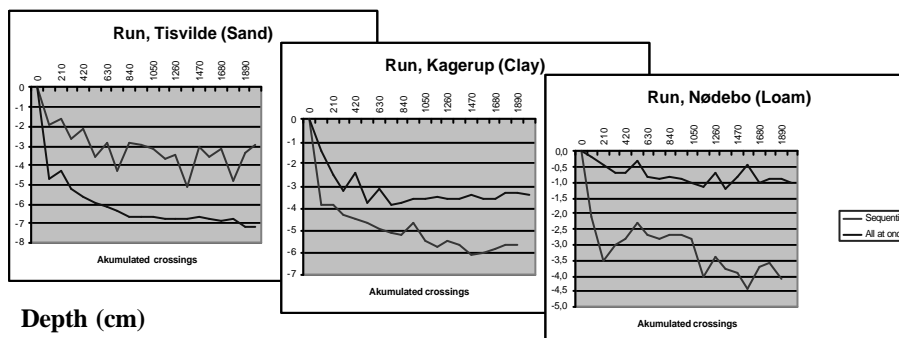
September 2006



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).



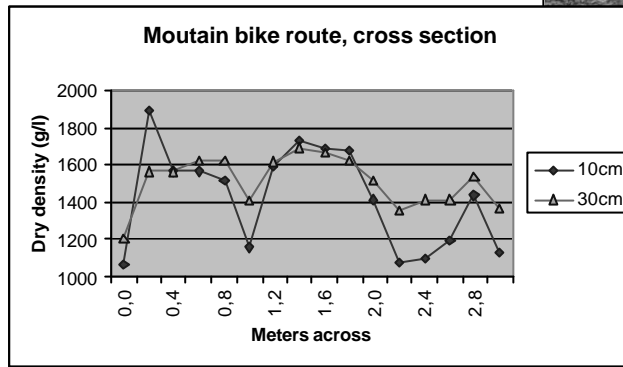


Skov & Landskab

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



Skov & Landskab

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...





Skov & Landskab

That's all...



Thank you for your attention

Hans Skov-Petersen
hsp@kvl.dk

Danish centre for Forest, Landscape and Planning
+45 35 28 18 16