


Mapping of natural and artificial channel networks in forested landscapes using LiDAR data to guide effective ecosystem management

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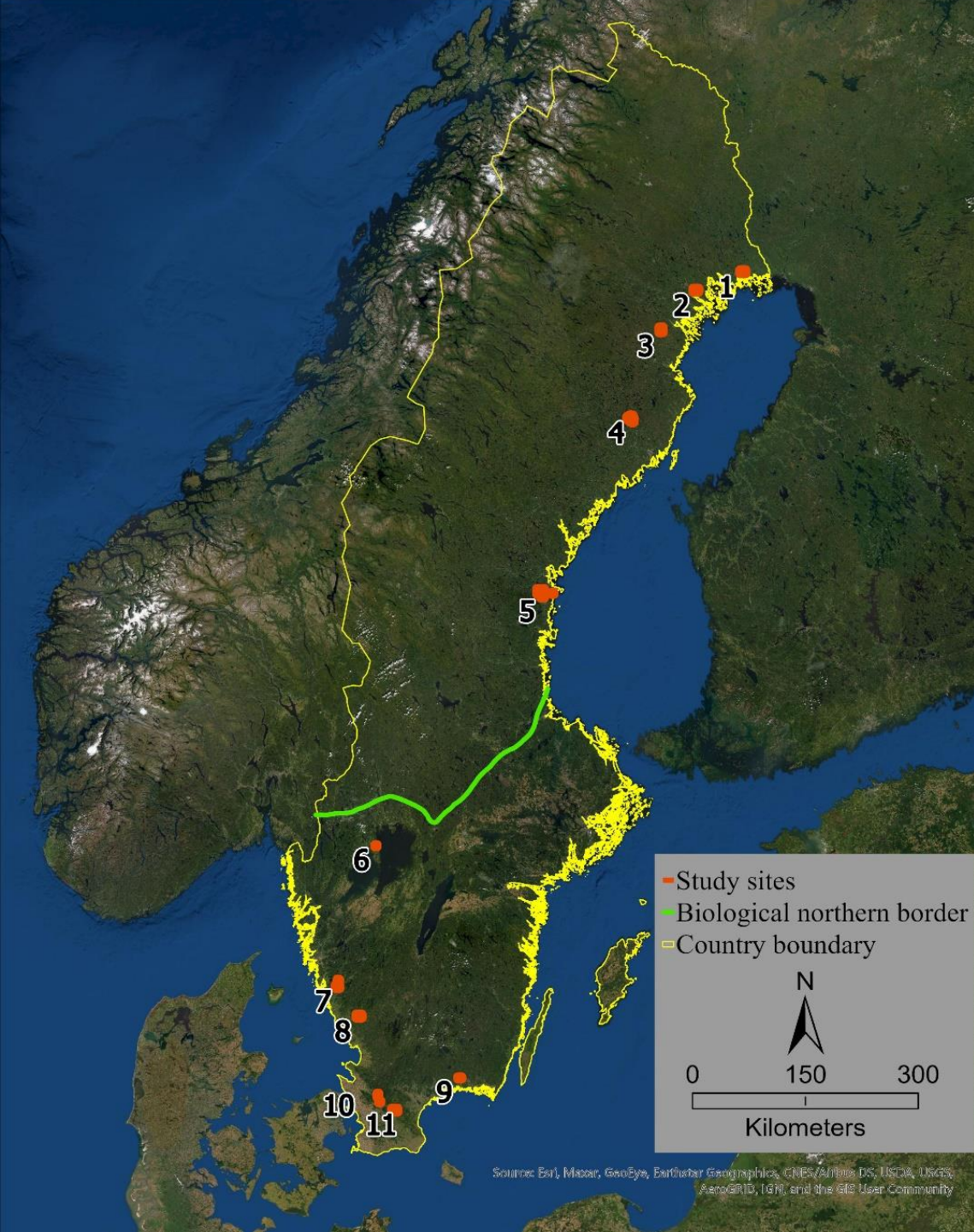
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- **Ditching** – one of the most spectacular features of the northern regions of Europe and North America
 - About 15 million ha of wetlands in northern boreal forests have been drained over the last century (Paavilainen and Päivänen 1995)
 - Peatland, mineral soils, cryptic wetlands

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- In Sweden, 95% of the total stream and river length are low-order streams (Wallin et al. 2018)
 - Currently on national map:
 - Natural channels – 45%
 - Straightened channel – 25%
 - Ditches – 9%

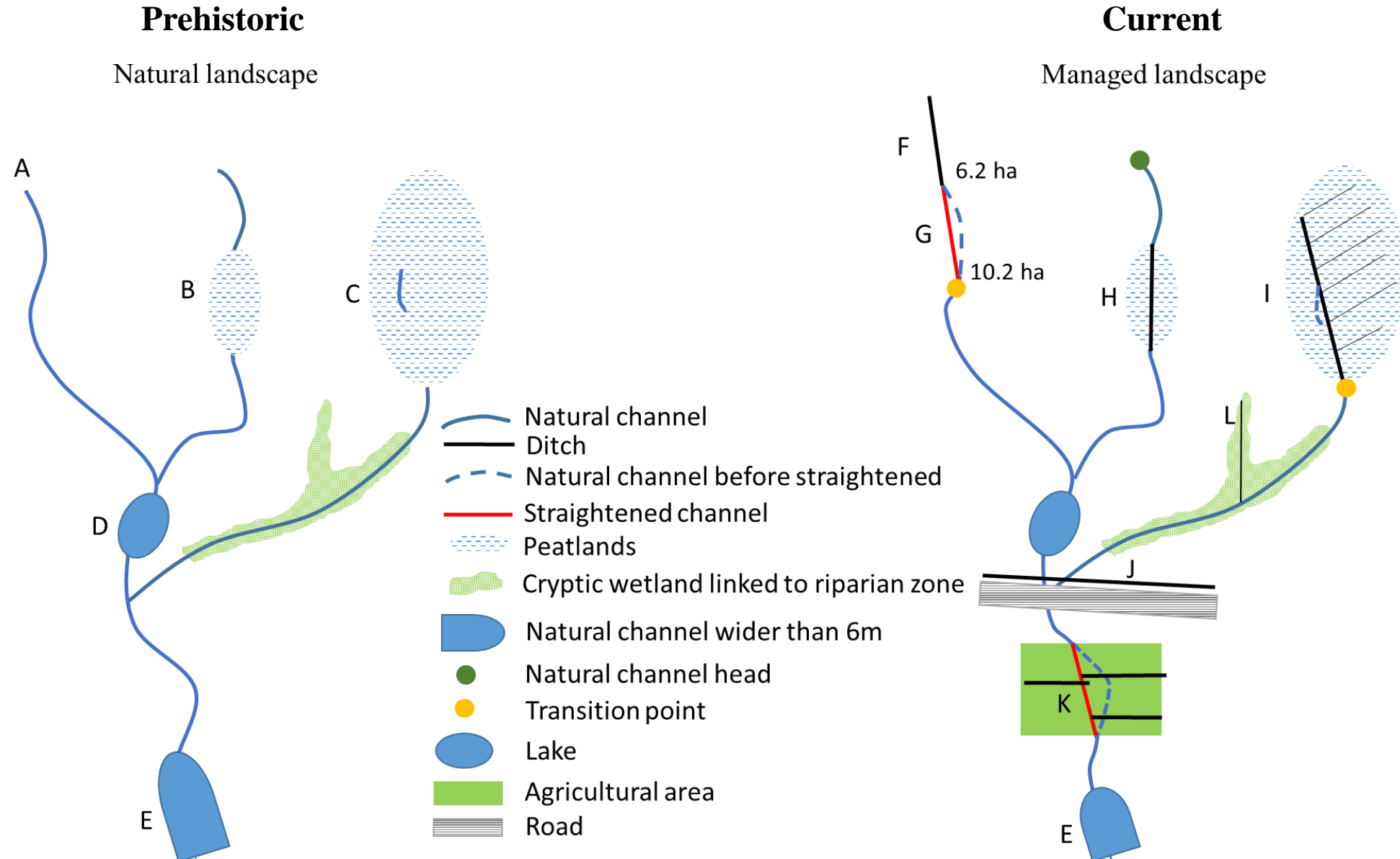
Light Detection and Ranging (LiDAR)





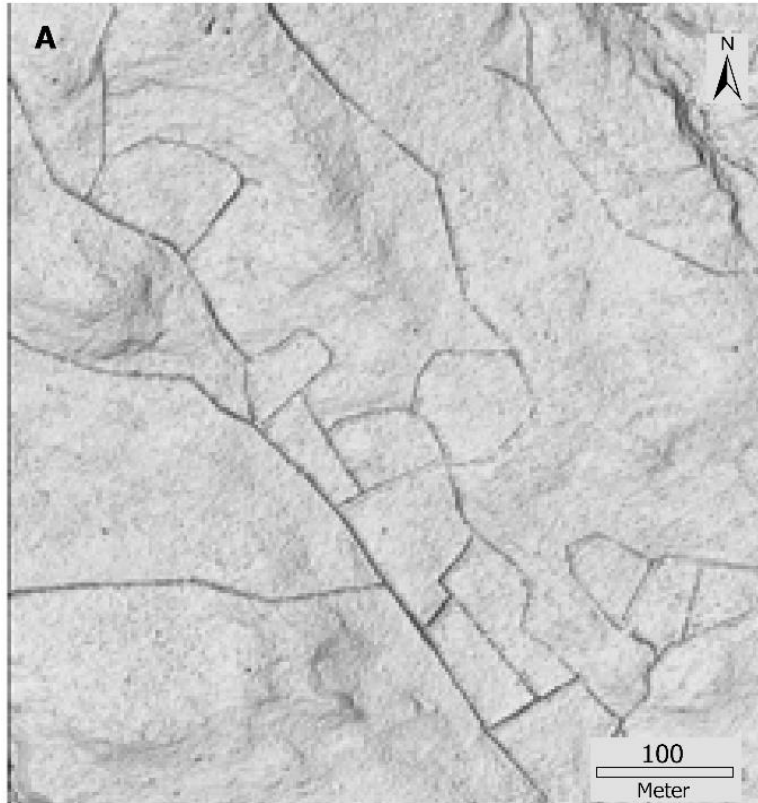
- Map the extent of current channel network across 11 study regions in Sweden
- Virtually reconstruct the prehistoric landscape (when there was no ditches) and map the natural channels
- 0.5 m resolution LiDAR data

Conceptual diagram showing the components of natural and man-made channel networks

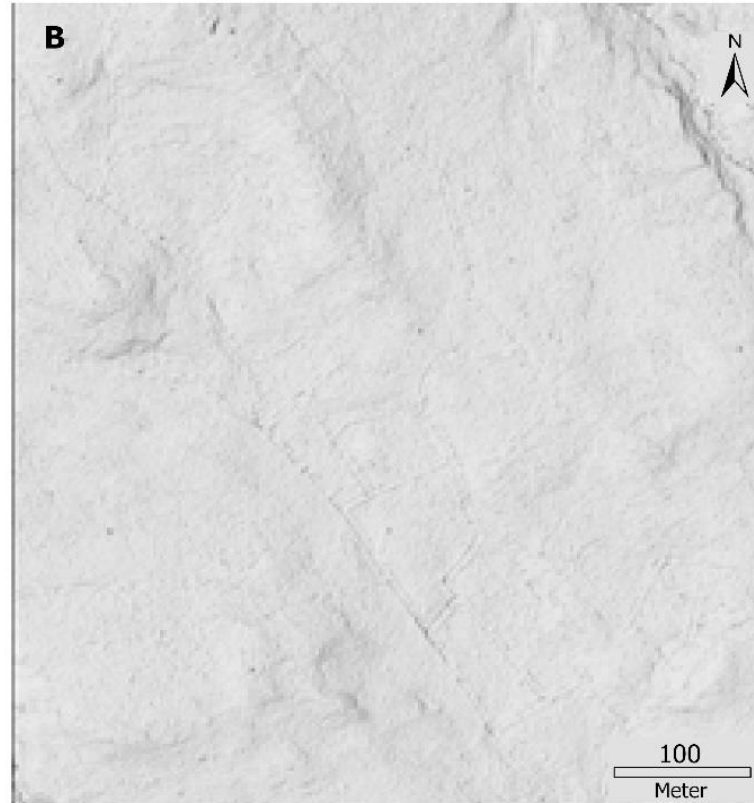


Mapping current natural channel network

- Detecting the natural channel heads
- Tracing the downstream channels from the heads
- Manual editing of the channels



Current landscape with
ditches



Modeled ditch-filled
prehistoric landscape

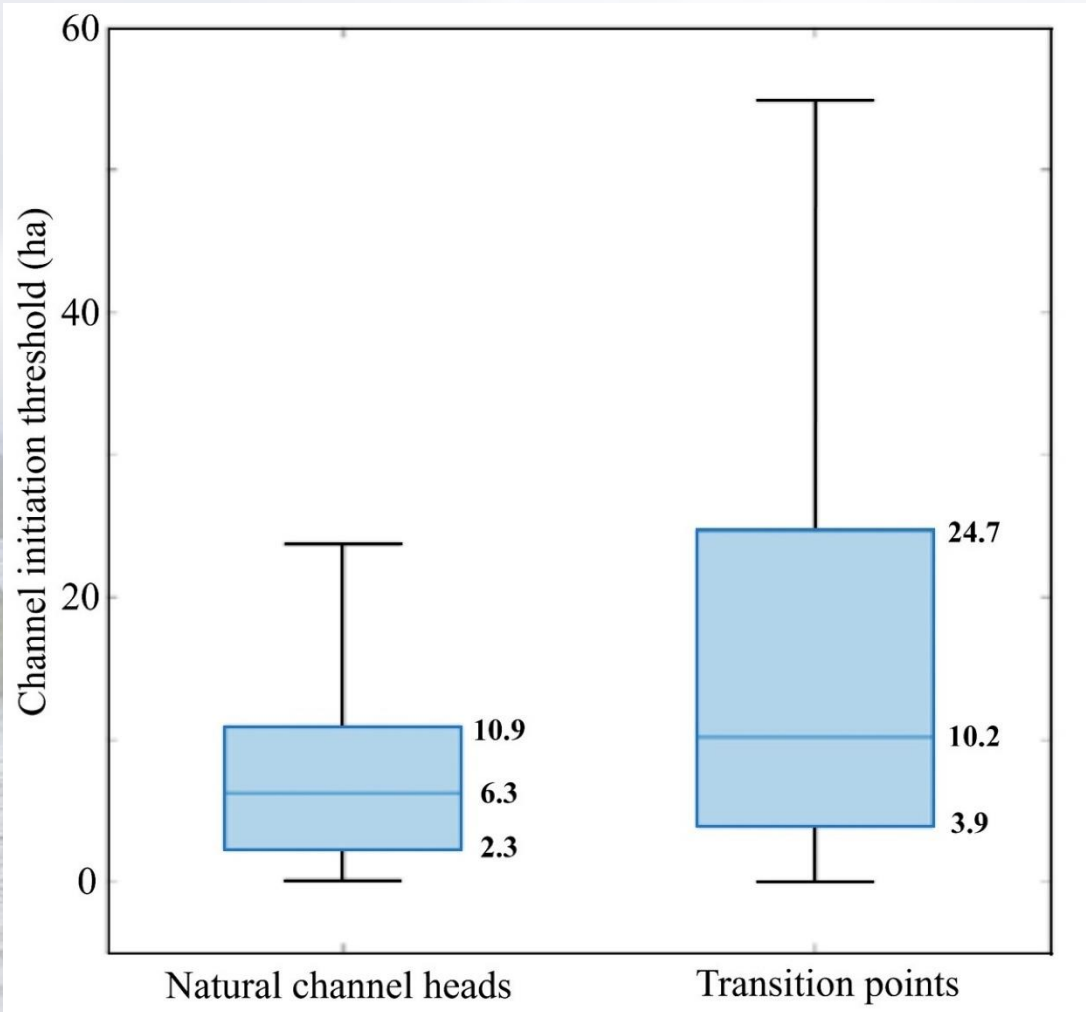
Modeling prehistoric natural channel network

- Impoundment Size Index
- Flow initiation thresholds –
2.3 ha, 6.3 ha, and 10.9 ha

Mapping of man-made ditch network

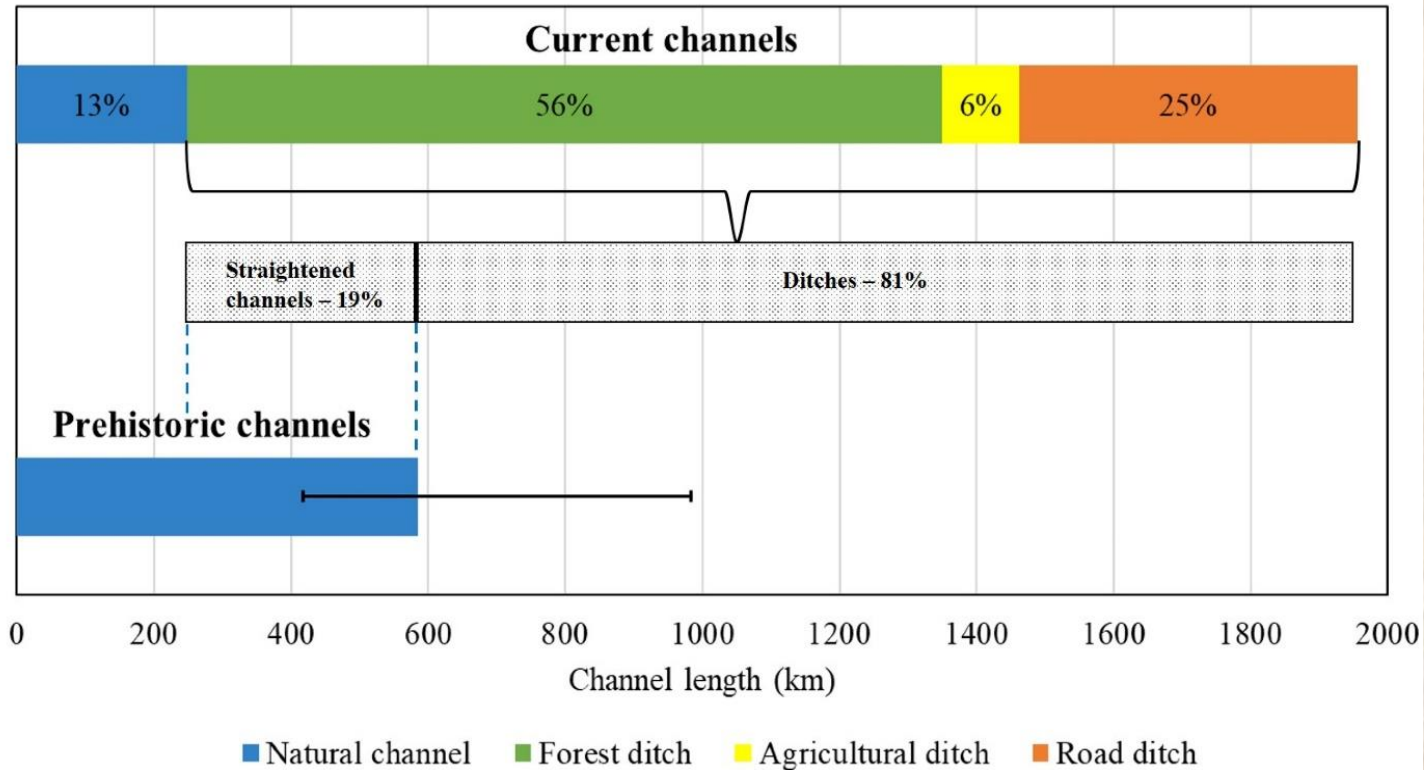
- High-pass median filter,
hillshade
- Historical air photos

Results



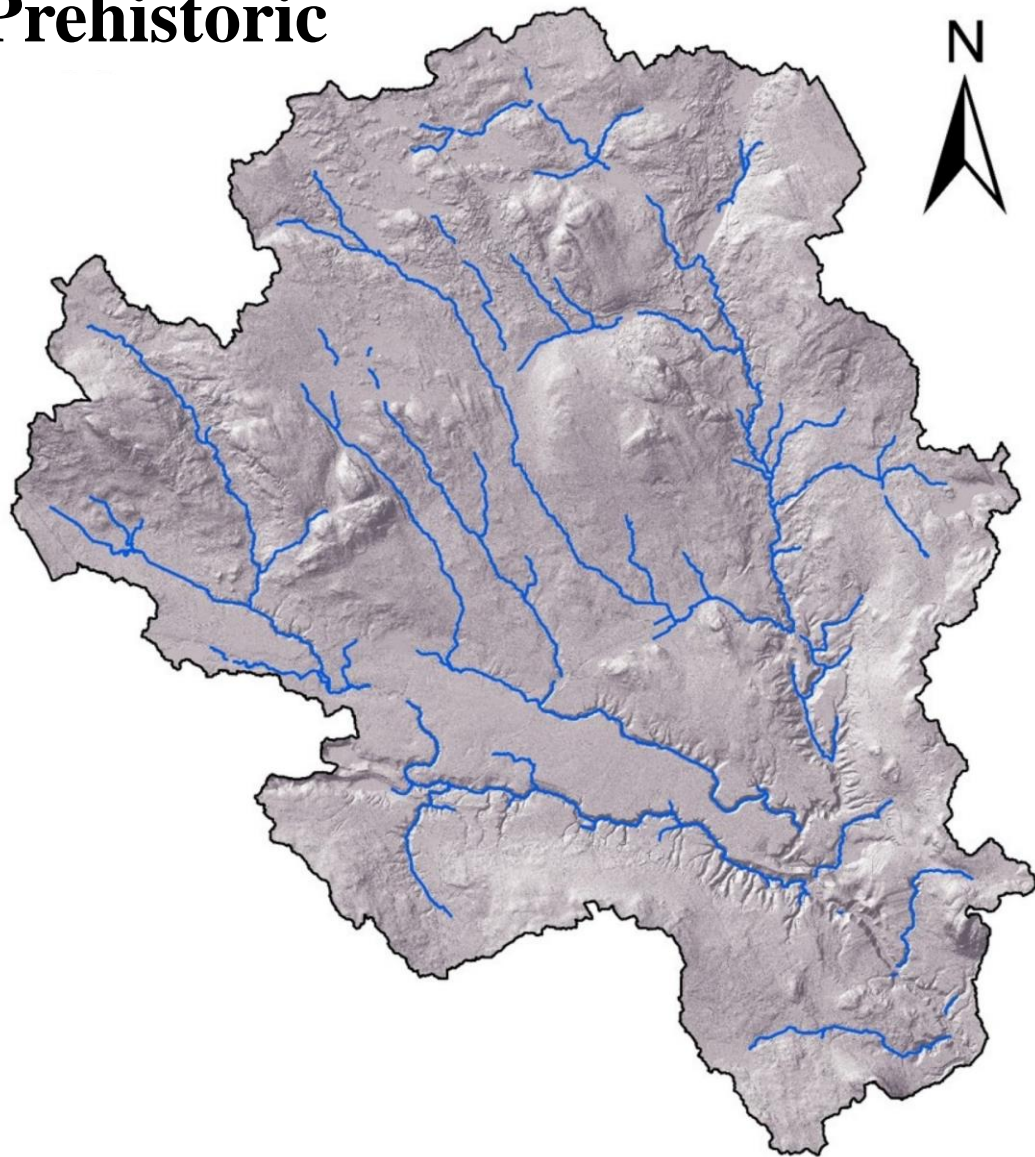
- **Transition points:** where natural channels connect to upstream ditch network
- Total of 394 channel heads; 58% were natural heads
- **Natural channel heads**
 - Northern study regions – 64%
 - Southern study regions – 36%
- **Transition points**
 - Northern study regions – 44%
 - Southern study regions – 56%

Length of current and prehistoric channels

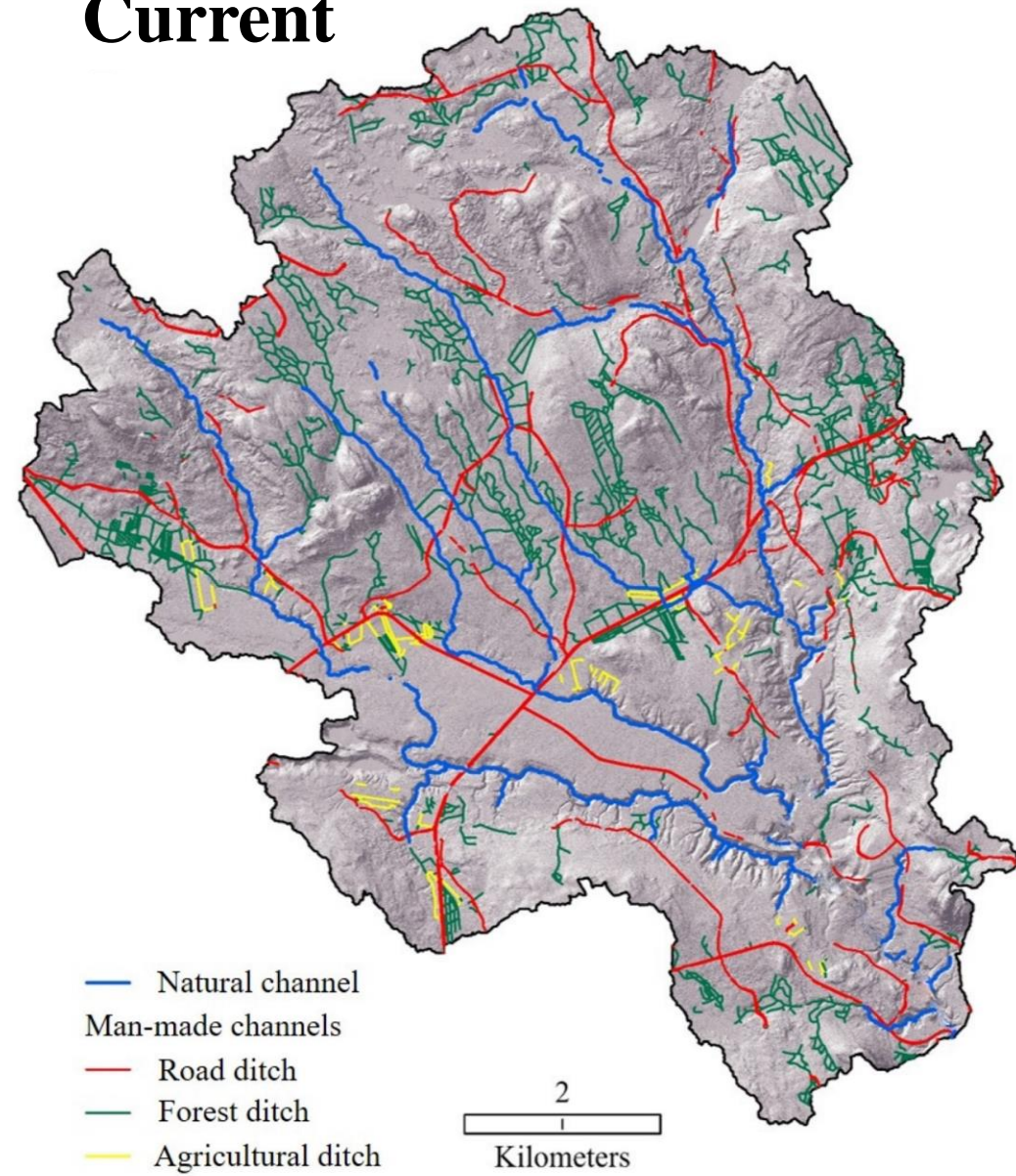


- Current channel network – 1955 km
- 87% is artificial ditches
- Prehistoric channel network – 584 km
- Channel density
 - Current landscape : 4.66 km km^{-2}
 - Prehistoric landscape: 1.33 km km^{-2}

Prehistoric



Current



Conclusions

- We found that ditching is the largest man-made alteration of the Swedish natural landscape which likely has significantly impacted the soil, hydrology, and forest ecosystems as well as GHG balances
- Our methodology can be used to inform site-specific land management, prioritize ecological restoration of wetlands, and improve hydrological monitoring in Sweden
- The methodology can be implemented in any northern landscape for understanding the extent of human modification of natural channel networks to guide future environmental management activities and policy formulation

A photograph of a winter scene featuring a snow-covered path that leads into a forest. The trees are heavily laden with snow, and the ground is a smooth, white expanse. In the distance, two small figures of people can be seen walking along the path. The sky is a clear, pale blue.

Questions?

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