Long term changes in riverscapes in rivers regulated for hydropower.

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ABSTRACT: Development of storage-based hydropower alters flow regimes in rivers and thereby induces changes in seasonal distribution flow distribution, changes water covered areas of rivers, reduces the natural flood regime, and alters sediment transport mechanisms. The alterations in the natural flow regime and processes associated with flow can have long term effects on riverscapes, changing the distribution of habitat types and cause loss of important habitat seen on longer time scales which again influence biodiversity in regulated rivers. Several endangered riparian habitats need more attention and restoration efforts to enable a more biodiversity positive development of Norwegian riverscapes, in line with UN IPBES and to reach SDGs for healthy ecosystems

Describing such changes and proposing mitigation measures is a complex process, mainly because a lack of good data describing the situation before the hydropower regulation was undertaken but also since it is difficult to disentangle other factors influencing the riverscapes such as changes in climate and other anthropogenic impacts like agriculture, urbanisation, and road development.

Here we combine historic aerial imagery from the repository of the Norwegian mapping authority with a convolutional neural network to classify historic habitats in several rivers in Norway to establish pre-regulation conditions. Further, then the same methodology is used to classify imagery over the years after the regulation to make a database of riverscape development over time. The next step is to use GIS based algorithms to describe changes in habitat over time and to quantify the alteration. Data on climate development, anthropogenic factors and changes in floods and other flow regime components are then compiled and used to evaluate which factors drives changes in rivers. To better separate effects of regulation from other factors, we contrast the development in regulated rivers with unregulated rivers close by to properly attribute e.g., changes in vegetation to natural and regulation driven processes.

Results show reduction in point bars, infilling and loss of side channels and river braids and increased vegetation on previous open river bars. A consequence is narrowing of channels and shrinkage of open floodplains which is both an environmental issue and critical in flood conveyance.