

The effects of logging residue extraction for energy on ecosystem services and biodiversity: A synthesis

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In Northern Europe, **slash** (i.e. tops and branches from harvested trees) is harvested after clear-felling and used for bioenergy. In Northern America, whole-tree harvesting (i.e. tops and branches are harvested at the same time as the stem) is more frequent.



In Northern Europe (esp. Finland), **stumps** are harvested after clear-felling and used for bioenergy. Slash and stump harvest are the two main types of **logging residue extraction**.

Abstract:

We have reviewed the consequences for biodiversity and ecosystem services from the industrial-scale extraction of logging residues (tops, branches and stumps from harvested trees and small-diameter trees from thinnings) in managed forests. Logging residue extraction can be used in place of fossil fuels, and thus contribute to climate change mitigation. However, the additional biomass and nutrients removed, and soils and other structures disturbed, have several potential environmental impacts. We found 279 scientific papers that compared logging residue extraction with non-extraction, the majority of which were conducted in Northern Europe and North America. It has been found that logging residue extraction can have significant negative effects on biodiversity, especially for species naturally adapted to sun-exposed conditions and the large amounts of dead wood that are created by large-scaled forest disturbances. Slash extraction may also pose risks for future biomass production, due to the associated loss of nutrients. For water quality, reindeer herding, mammalian game species, berries, and natural heritage the results were complicated by primarily negative but some positive effects, while for recreation and pest control positive effects were more consistent. Further, there are initial negative effects on carbon storage, but these effects are transient and carbon stocks are mostly restored over decadal time perspectives. Some of the negative effects can be decreased by avoiding extraction of certain categories of residues, and forest type targeted for extraction: for instance, to minimize risks for biodiversity stump harvesting should be a low level, but for future biomass production slash extraction should be avoided in certain forest types. Compensatory measures for logging residue extraction may also be used (e.g. ash recycling, liming, fertilization), though these may also be associated with adverse environmental impacts.

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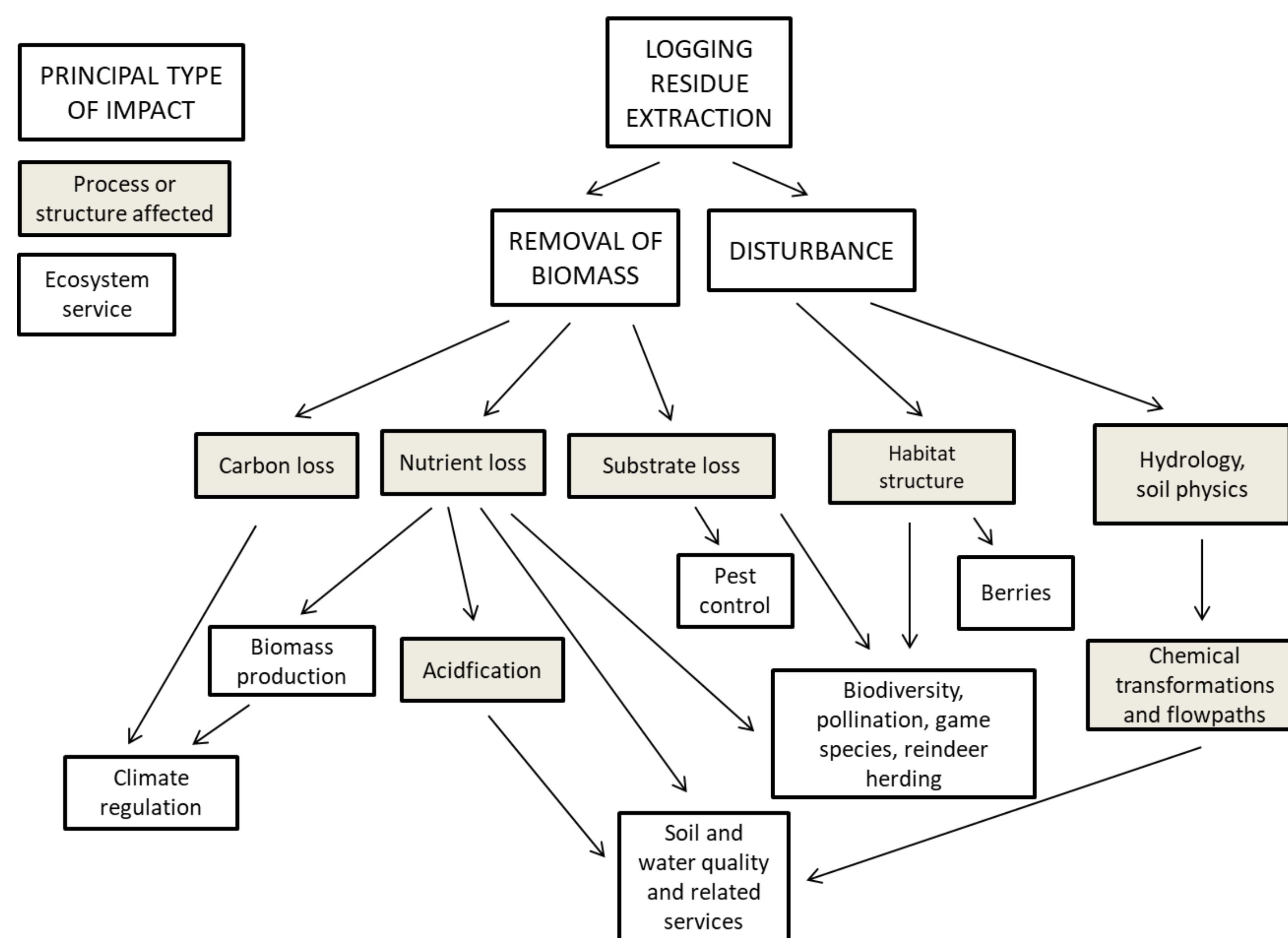
Photos: Gustaf Egnell, Bengt Olsson, Jörgen Sjögren

Our project – a global literature review

We reviewed the consequences for biodiversity and ecosystem services from the industrial-scale extraction of logging residues in managed forests.

Results: types of effects on ecosystem services

- For many: Intensification of forestry (clear effects, but small in comparison to stem-wood harvest in itself)
- For some: Additional effects in relation to stem-wood harvest due to more nutrients in slash and more soil disturbances when harvesting stumps
- For some: only small or even positive effects



Possible consequences of logging residue extraction on ecosystem services and biodiversity, and processes or structures that are mediating the effects.

Important positive effect



Low-carbon emission energy source (at a short-term scale esp. for slash)

Important risk at slash harvesting



Risk for biomass production in the next generation, especially at nutrient-poor sites

Important risk at stump harvesting



Risk for biodiversity associated with dead wood (esp. beetles and lichens) if done at a high extent