Restoration of flood-maintained ecosystems

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VATTENFALL

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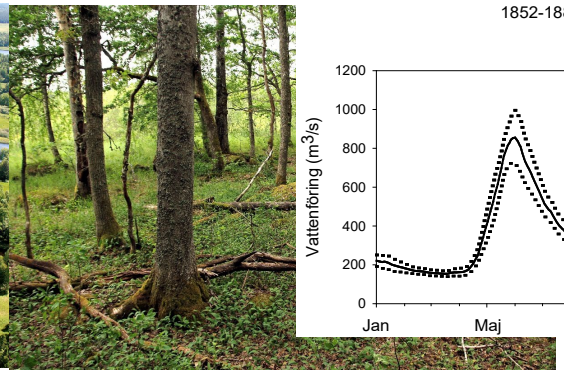
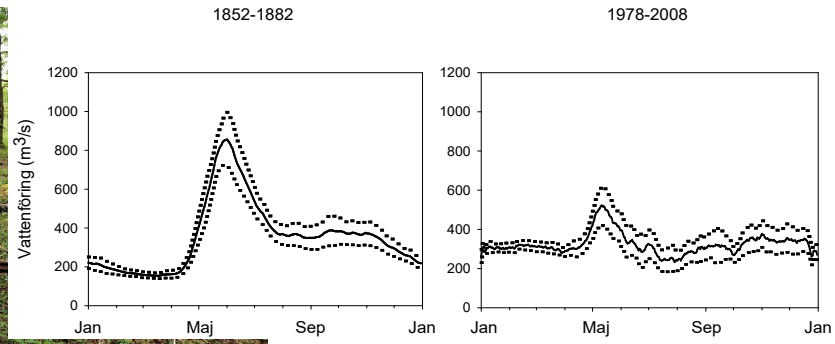
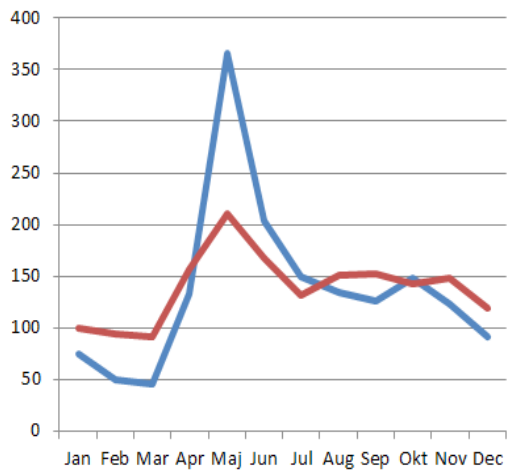
In **Dalälven:** flows to protect and rehabilitate alluvial forests and mixed riparian forests (EU-code 91E0 and 91F0), as well as northern alluvial riparian meadows (EU code 6450).

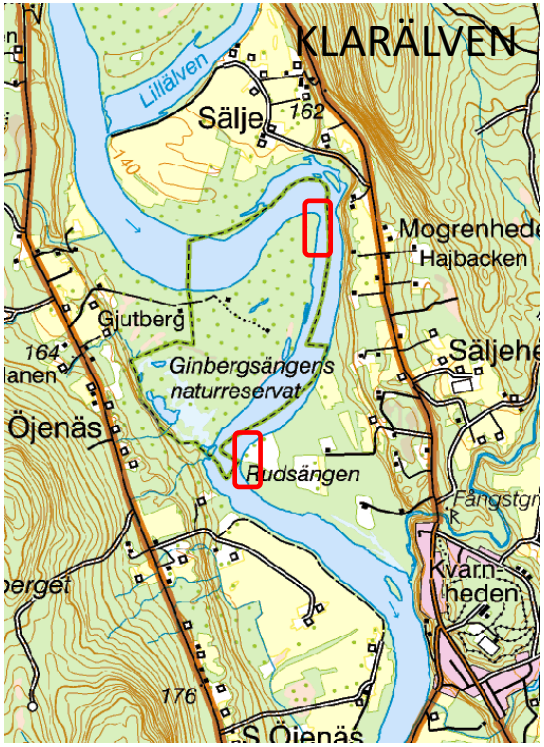


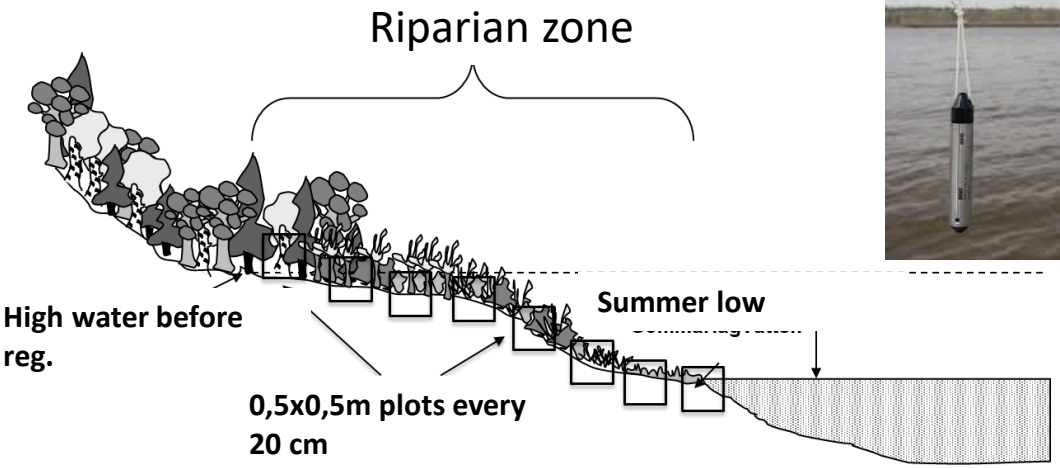


In **Klarälven:** flows needed to rejuvenate riparian zones in point bars in meandering rivers where natural vegetation dynamics is driven by sedimentation/erosion patterns.

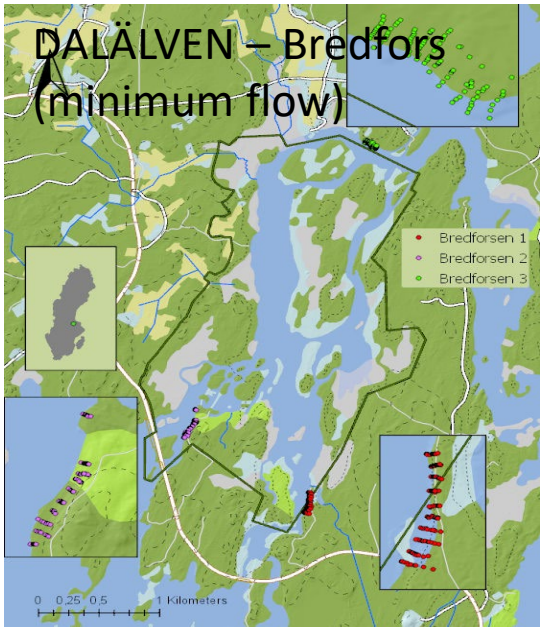


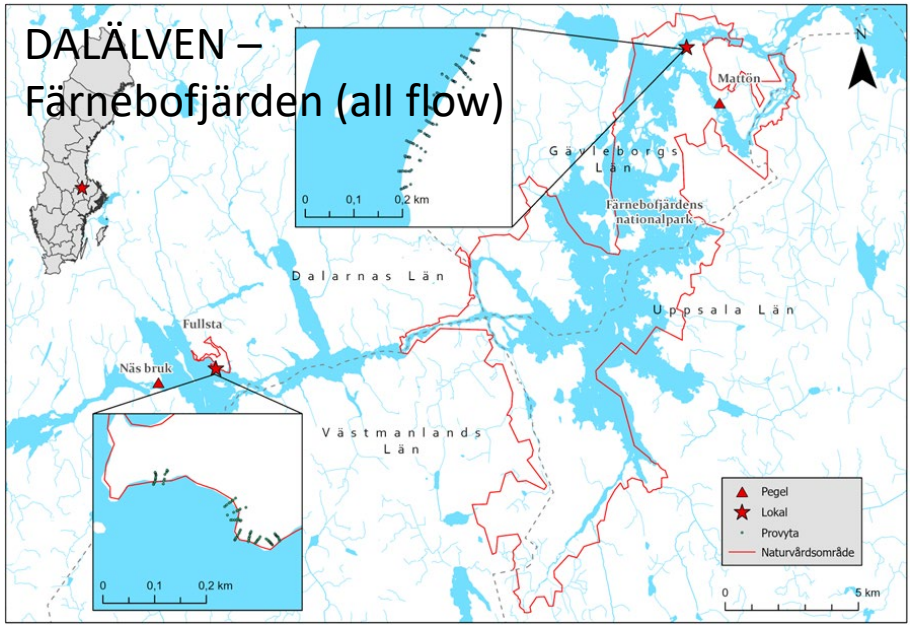
Inventory





Precence abcence riparian vegetation, vegetation cover, substrate composition. Position of each plot with a Network-RTK. Waterlevel logger – calculate flow dynamcis of each plot



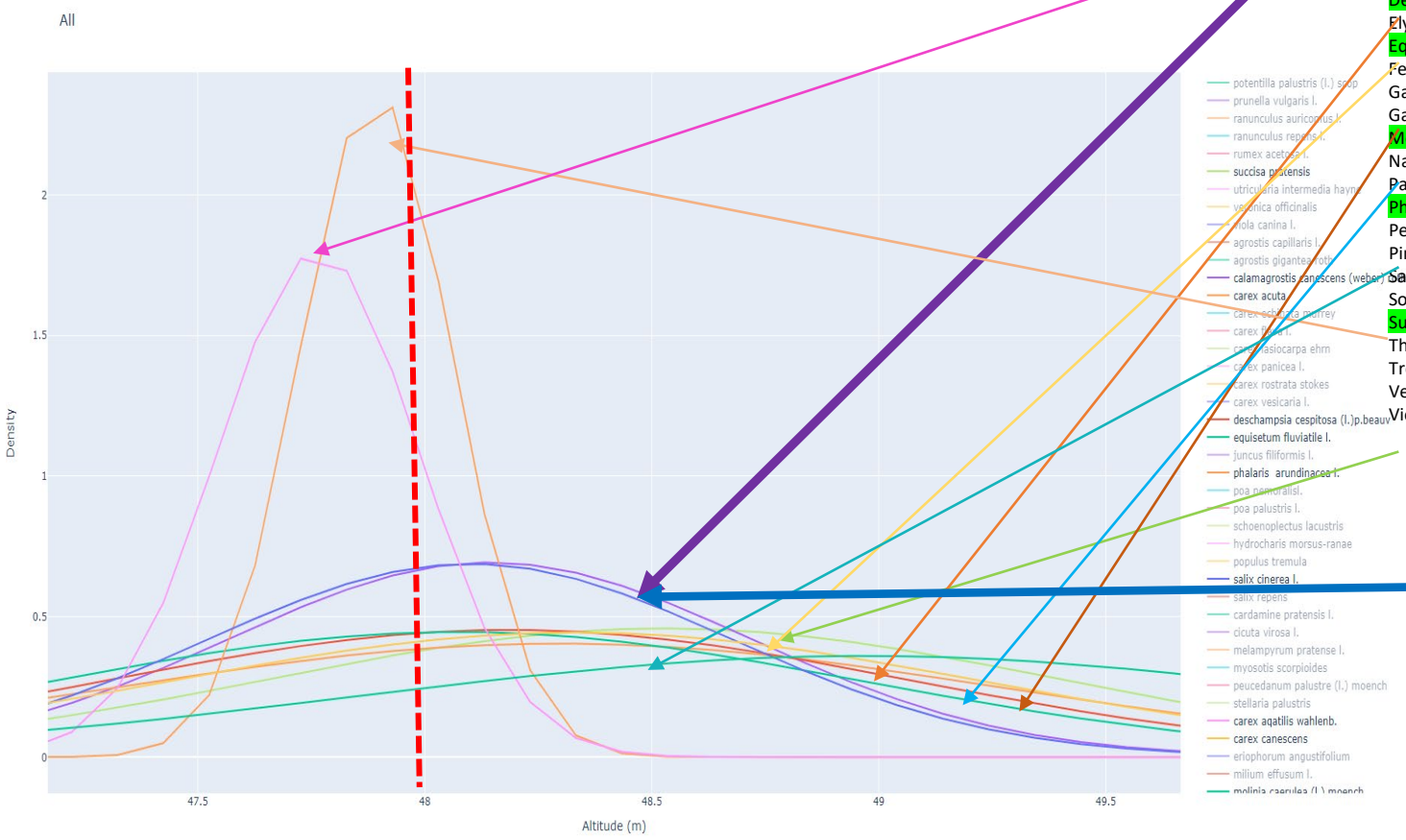


DALÄLVEN Species probability curves – alluvial meadows

Problems with encroachment of *Salix cinera*
Traditionally used for hay making – now grazing

”Wetter alluvial meadow”

”Dryer alluvial meadow”

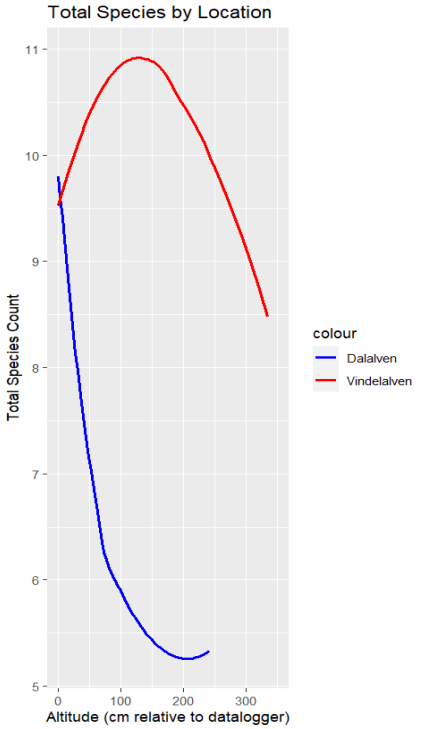


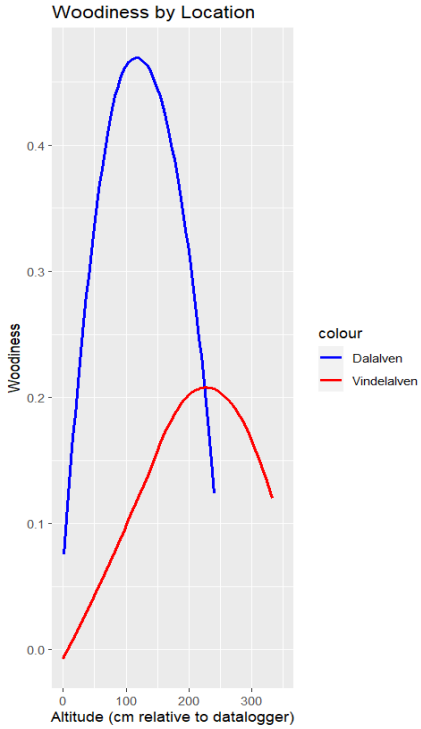
Typical and characteristic species

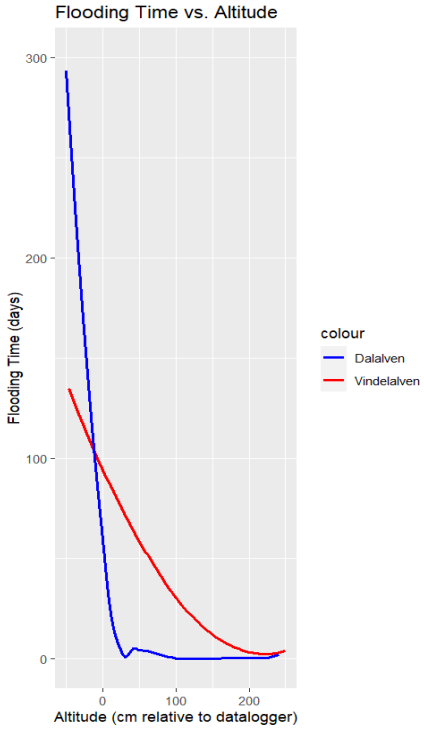
Typiska och karakteristiska arter
Bartsia alpina svarthö T-art
Calamagrostis canescens grenrör K-art
Calamagrostis purpurea brunrör K-art
Carex acuta vasstarr K-art
Carex aquatilis norrlandsstarr K-art
Carex canescens gråstarr K-art
Carex heleonastes myrstarr T-art
Carex pallescens blekstarr T-art
Deschampsia cespitosa tuvtåtel K-art
Elymus mutabilis lappelm K-art
Equisetum fluviatile sjöfräken K-art T-art
Festuca ovina fårsvingel K-art
Galium boreale vitmåra K-art
Galium uliginosum sumpmåra T-art
Molinia caerulea blåtåtel K-art
Nardus stricta stagg K-art
Parnassia palustris slåtterblomma T-art
Phalaris arundinacea rörflen K-art
Pedicularis palustris kärrspira T-art
Pinguicula vulgaris tätört T-art
Salix triandra mandelpil K-art
Solidago virgaurea gullris K-art
Succisa pratensis ängsvädd T-art
Thalictrum simplex ssp. boreale nordruta K-art
Trollius europaeus smörbollar K-art
Veronica longifolia strandveronika K-art
Viola palustris kärrviol T-art

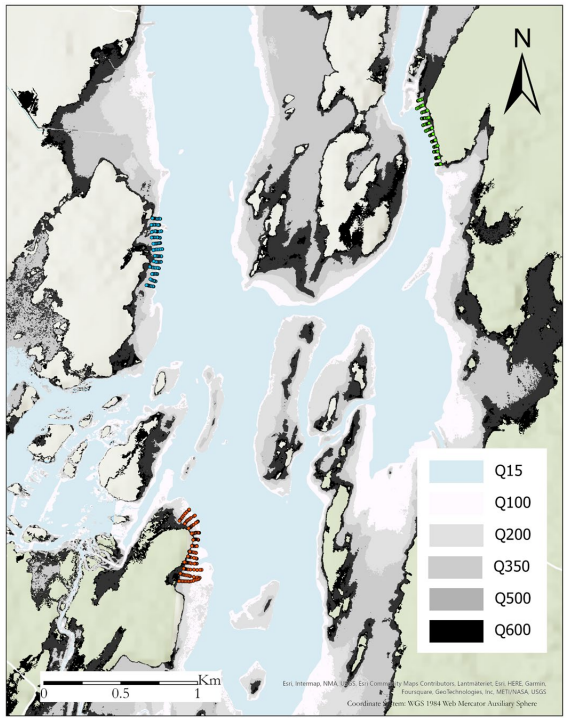
Salix cinera

DALÄLVEN – Alluvial meadows







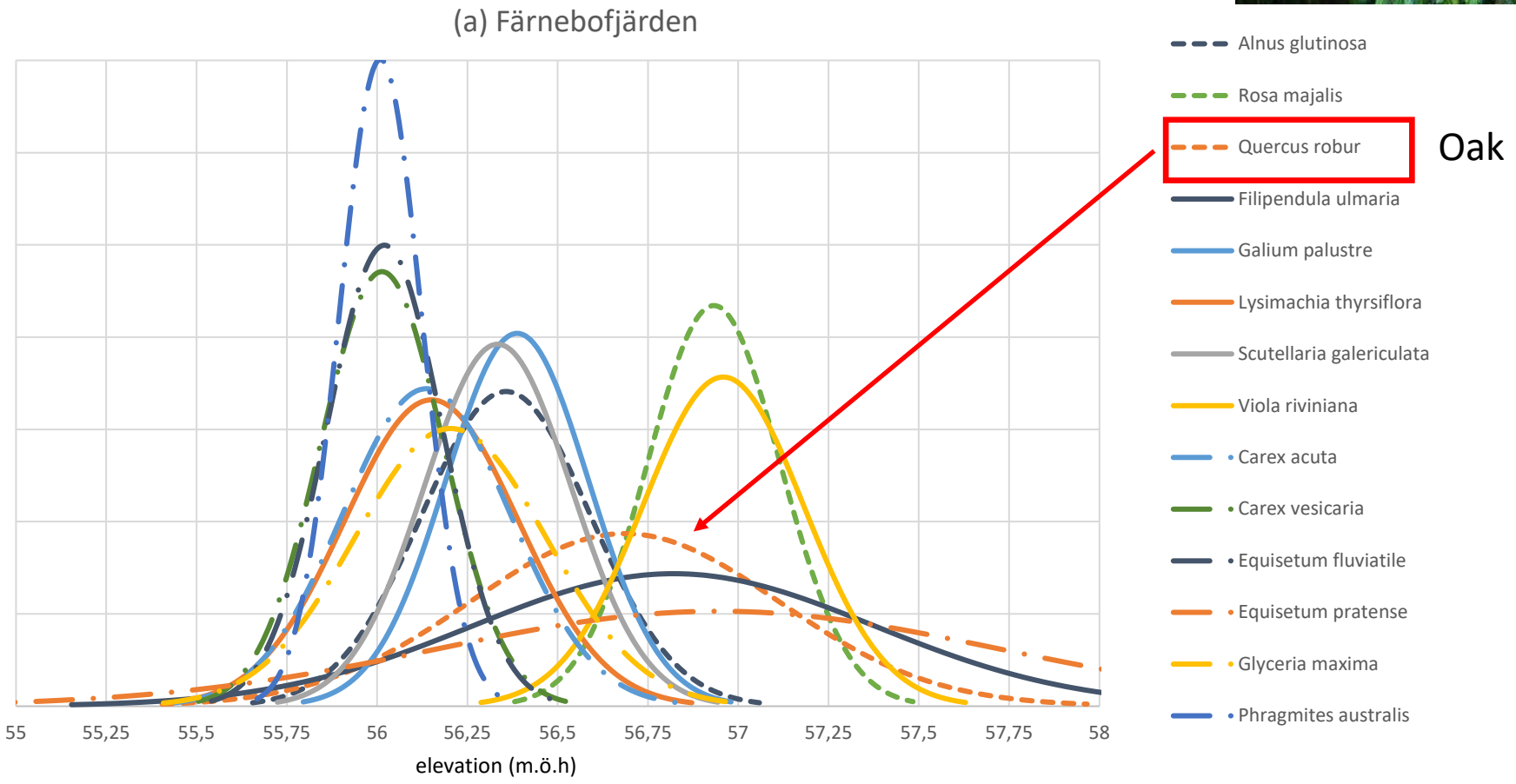


Higher and less static minimum flow will promote meadow vegetation – less dissrupt difference between wetter and dryer meadow – lower part likely less encroachment of *Salix cinera*. Modelling extent based on five different flow levels. **Duration?**

However *Salix* is a natural genus in alluvial meadows – encroachment also likely effect of stopped haymaking

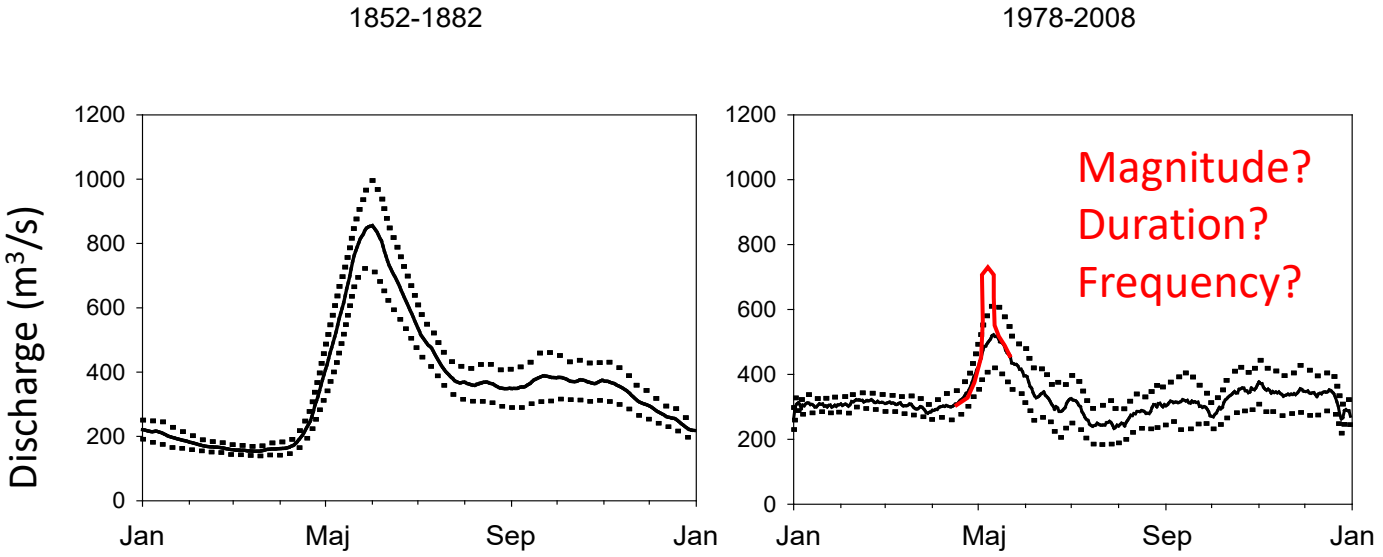
DALÄLVEN Alluvial forests and mixed riparian forests - Species probability curves

Loss of temperate deciduous forest species like oak (*Quercus robur*) due to encroachment of Norway spruce (*Picea abies*)



Oak

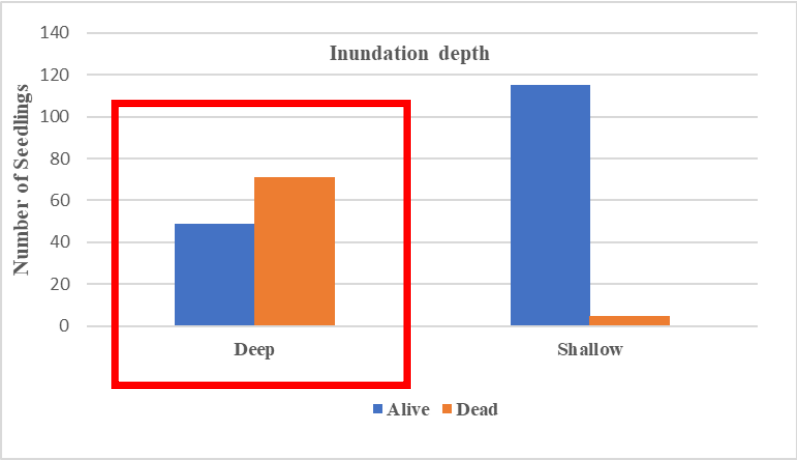
Alluvial forests and mixed riparian forests - Can we design high flow pulse that ”does the job of the natural spring flood” but is shorter and less frequent?



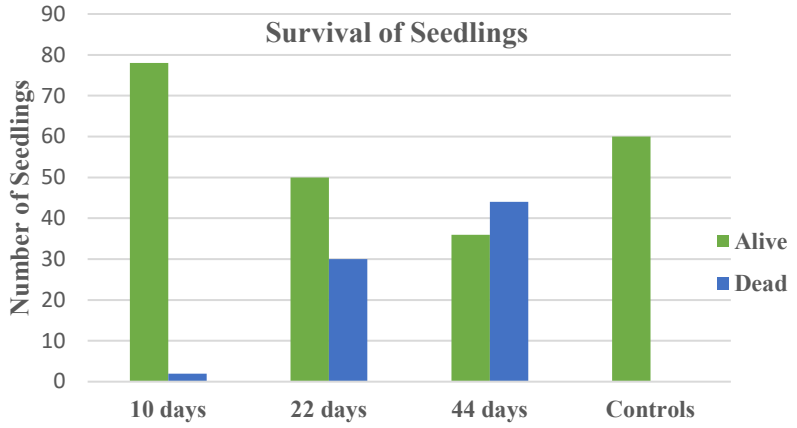
- Laboratory experiment with inundation – done this winter
- Transplantation experiment – this summer
- Occurrence of natural tree seedlings – next summer

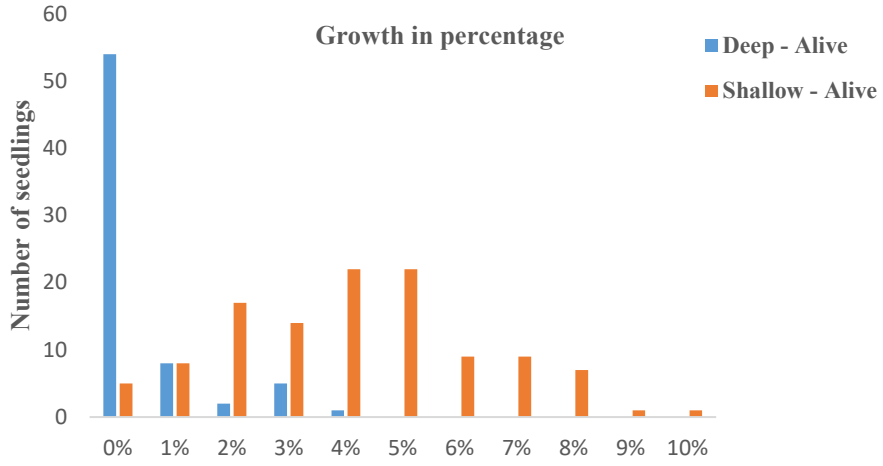
- Hypothesis: 2 weeks every 2nd year enough to exclude spruce seedlings (instead of >1 month/year)

Laboratory experiment with inundation – preliminary results

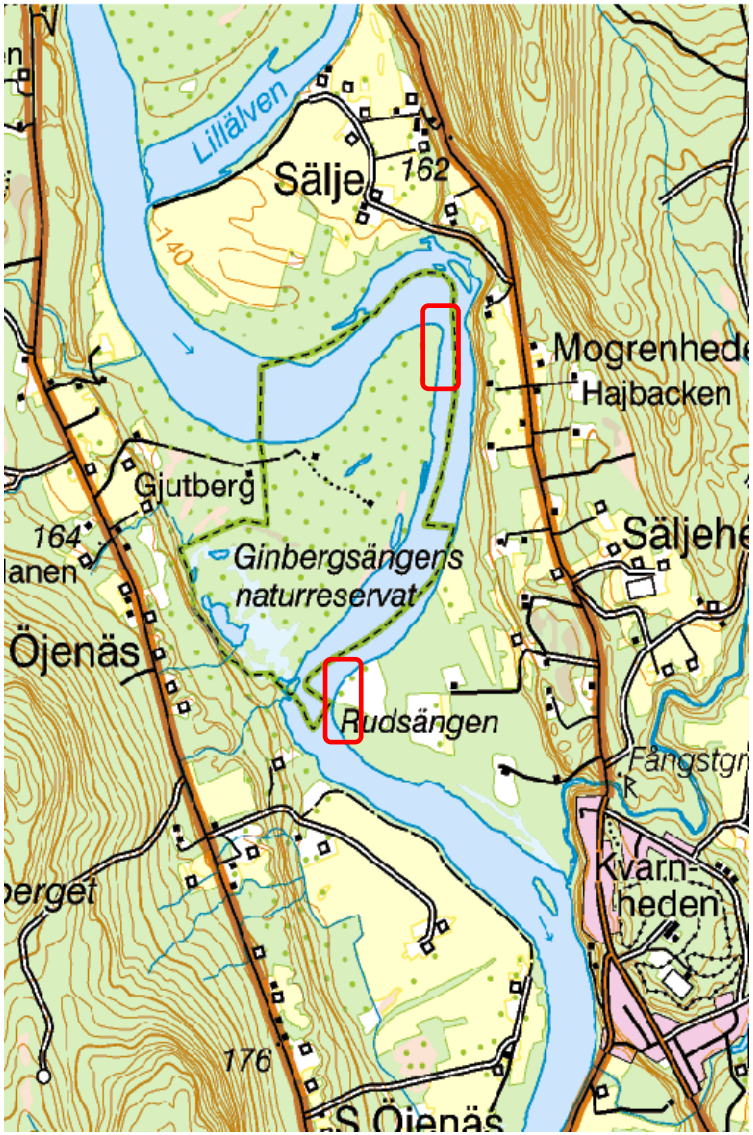


Since the laboratory experiment showed that a large proportion of spruce seedling died after being inundated for 22 and 44 days, reintroductions of floods shorter than the natural spring floods lasting about 1.5 months may be enough to aid in restore riparian forests dominated by oaks and other deciduous hardwood trees.





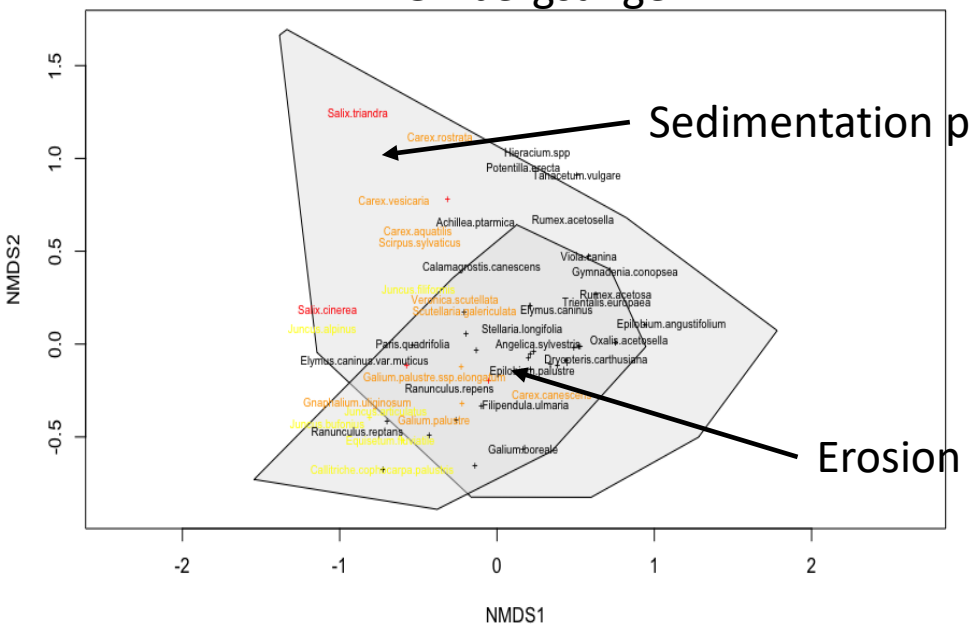
KLARÄLVEN - point bars in meandering rivers



Exploring erosion and sedimentaion sites

- Species richness and composition
- Regulation effects on vegetaion belt extent
- Relationship flow-sedimentation-erosion

Ginbergsängen

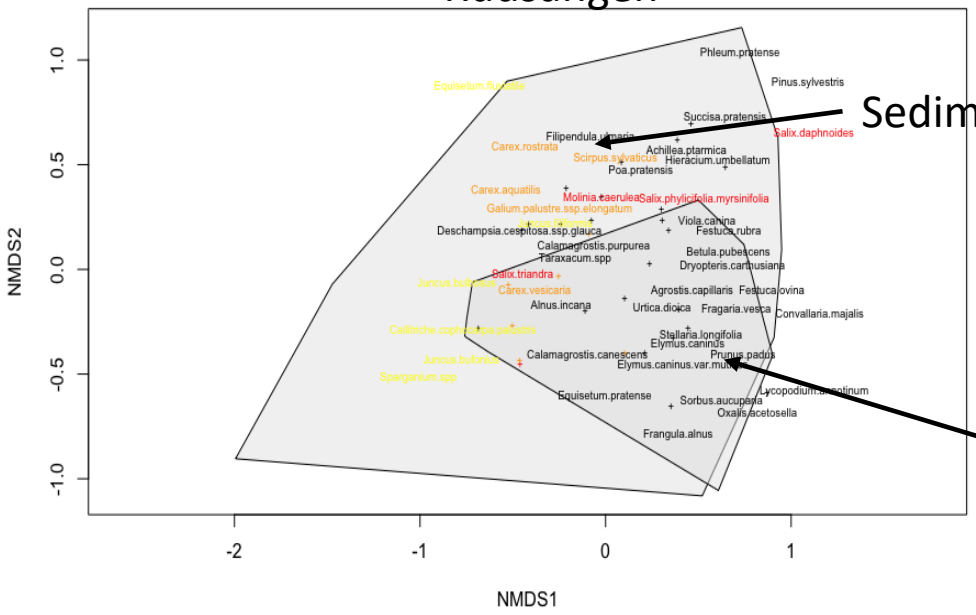


Sedimentation plots

Erosion plots

Unique species in sedimentaion plots, especially those belonging to the salix/alnus, and the graminoid zone

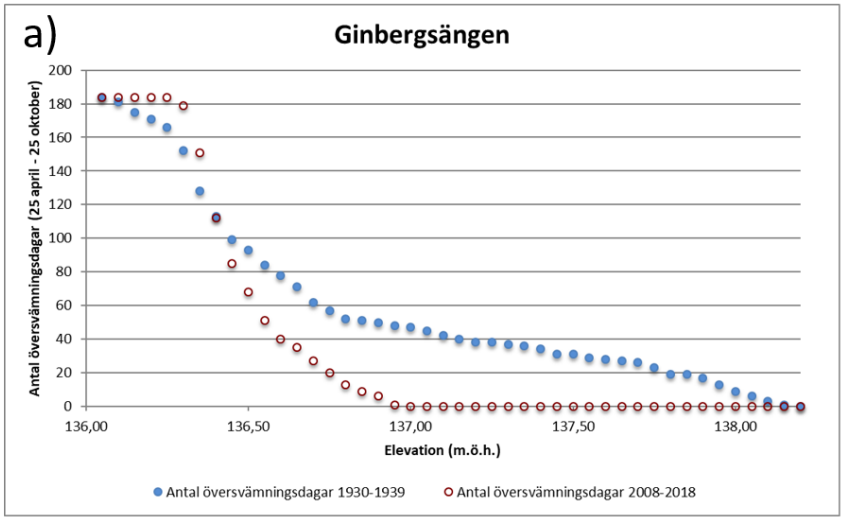
Rudsängen

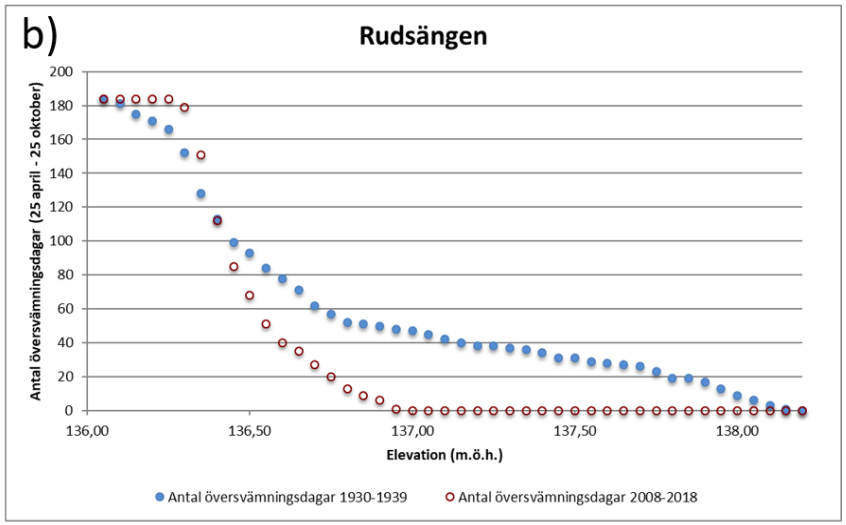


Sedimentation plots

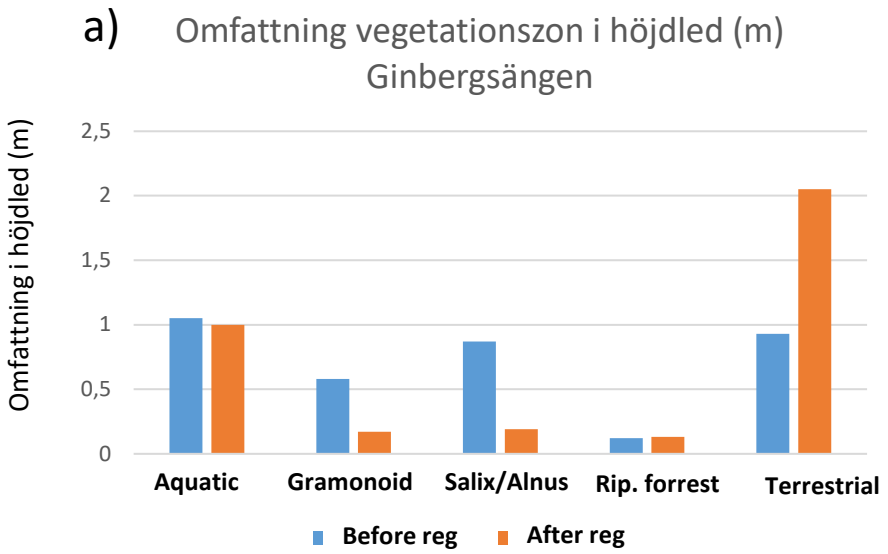
Erosion plots

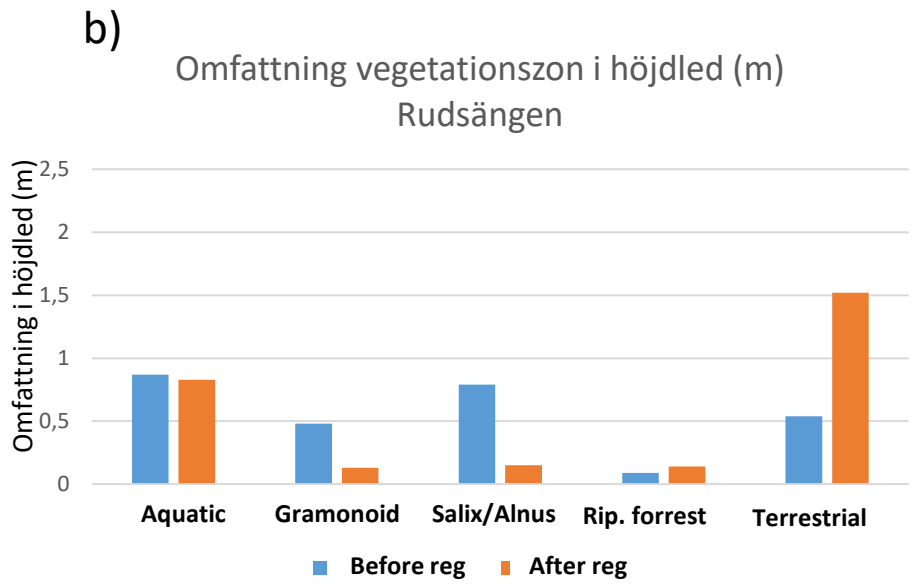
Change in flooding duration before and after regulation





Change in extent of vegetaion belts before and after regulation

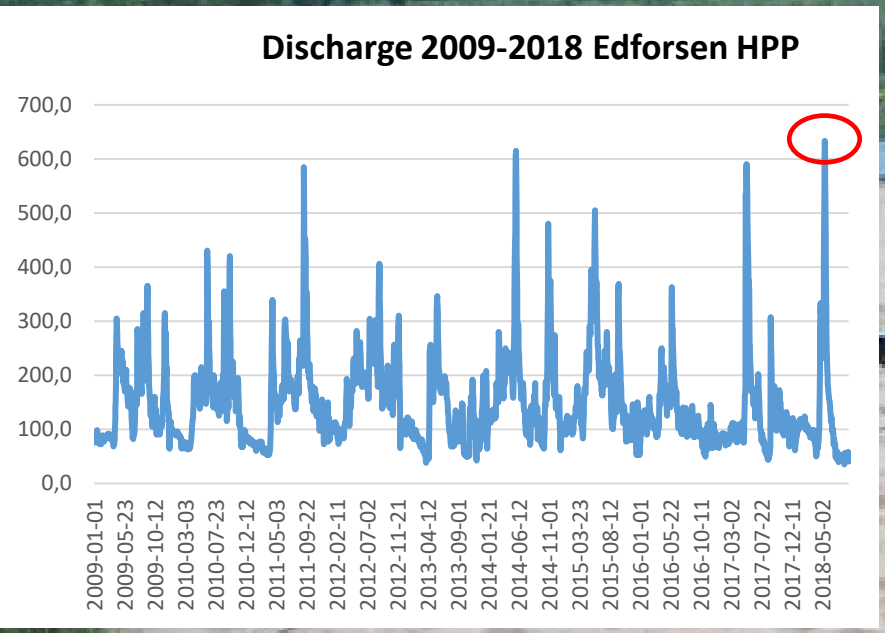




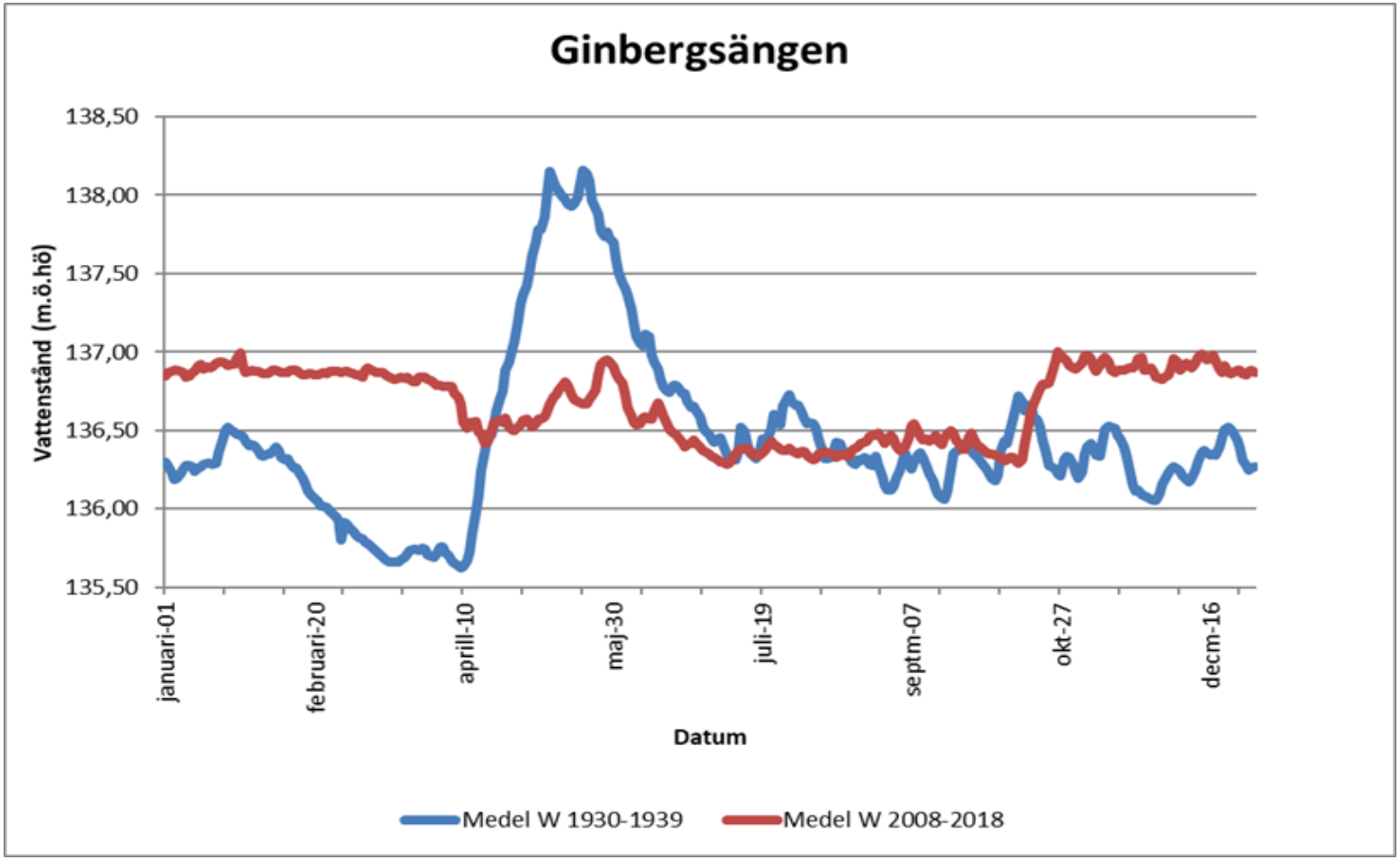
Environmetal flows to maintain Salix/alnus belts?

Vegtationszon	Upper before regulation (m.a.s.l)	Lower before regulation (m.a.s.l)	Upper after regultion (m.a.s.l)	Lower after regulation (m.a.s.l)	Change in zone (m)	Corresponding flow before regulation for higher upper limit of vegetaion zone
Ginbergsängen						Equation fig 4a
Aquatic	136,45	135,4	136,4	135,4	-0,05	
Graminoid	137.03	136.45	136.58	136.41	-0.41	302 m^3/s
Alnus/Salix	137,91	137,04	136,78	136,59	-0,68	505 m^3/s
Riparian forest	138,04	137,92	136,92	136,79	0,01	537 m^3/s
Terrestrial	138,98	138,05	138,98	136,93	1,12	
Rudsängen						Equation fig 4b
Aquatic	136,32	135,45	136,28	135,45	-0,04	
Graminoid	136.81	136.33	136.42	136.29	-0.35	297 m^3/s
Alnus/Salix	137,61	136,82	136,58	136,43	-0,64	507 m^3/s
Riparian forest	137,71	137,62	136,73	136,59	0,05	534 m^3/s
Terrestrial	138,26	137,72	138,26	136,74	0,98	

Flooding to manitain sediment deposition – erosion patterns



What if erosion is additional/bigger problem – sand bars disapear faster than build up?



Potential ice erosion with higher water levels compared to pre-regulation, and effects of ”hydropeaking”


Thank you!