

A close-up photograph showing several large, cut logs stacked together. The logs have a dark brown, textured bark and a lighter-colored, radial-grained wood surface.

Utilization of high resolution harvester production data for improved pre-harvest planning and follow-up

Johan J Möller, Jon Söderberg, Nazmul Bhuiyan, John Arlinger, Björn Hannrup, Maria Nordström.....

A photograph of a blue harvester operating in a forest. The machine is shown from a side-on perspective, with its long conveyor belt extending from the back towards the front. The word "H21D" is visible on the side of the cab. The harvester is surrounded by tall, thin pine trees. In the foreground, there is a large pile of cut logs and branches.

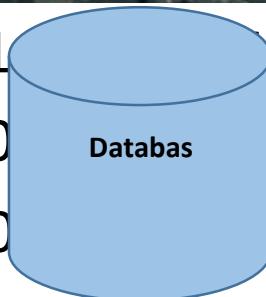
Content of presentation

1. Describe StanForD 2010 data used in the system
2. Describe how we use harvester data for pre harvest assessment (prognosis)
3. Describe example how of use data for thinning follow up



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Structure of harvester data according to StanForD 2010 – individual data - hpr

Tree	Species	DBH	X	Y	Crane angel
1	Spruce	330	6347115	1481603	25

458

272



Structure of harvester data according to StanForD 2010 – individual data

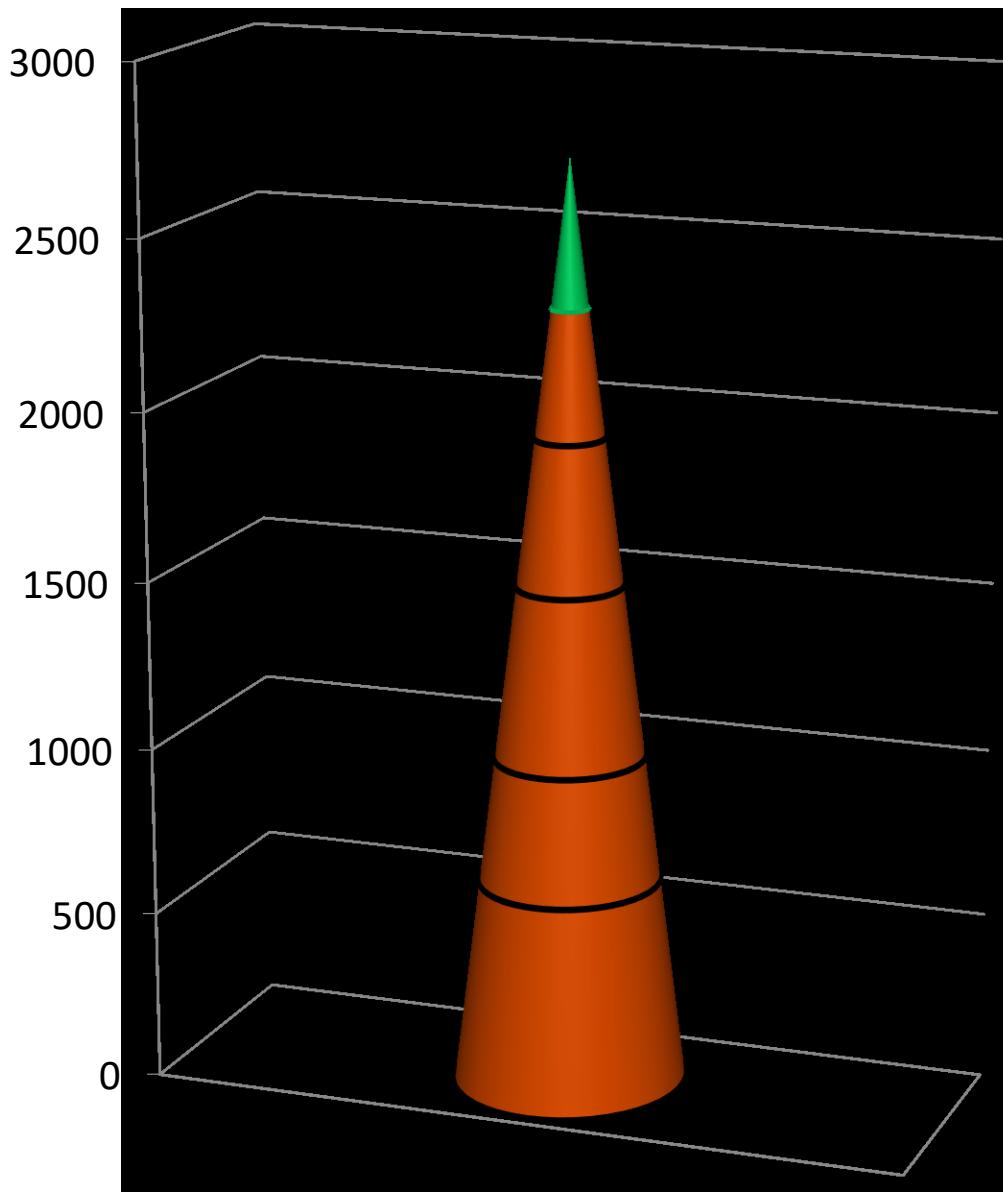
Tree	Species	DBH	X	Y	Bio adapted
1	Spruce	330	6347115	1481603	1

Tree	Log	Assortement	Top diameter	Mid diameter	Length
1	1	Saw timber	271	302	553
1	2	Saw timber	233	252	432
1	3	Saw timber	196	212	512
1	4	Small timbr	165	178	342
1	5	Pulp	95	132	491

458 272
COE

Recreating stems step 2

Tree height, cm



58



272

CO₂ 2%

An aerial photograph of a forest showing a mix of green and yellow autumn foliage. A red vehicle, possibly a harvester or truck, is visible on the left side. The forest floor appears dark and uneven.

Forest is re-created.....
or the felled forest....

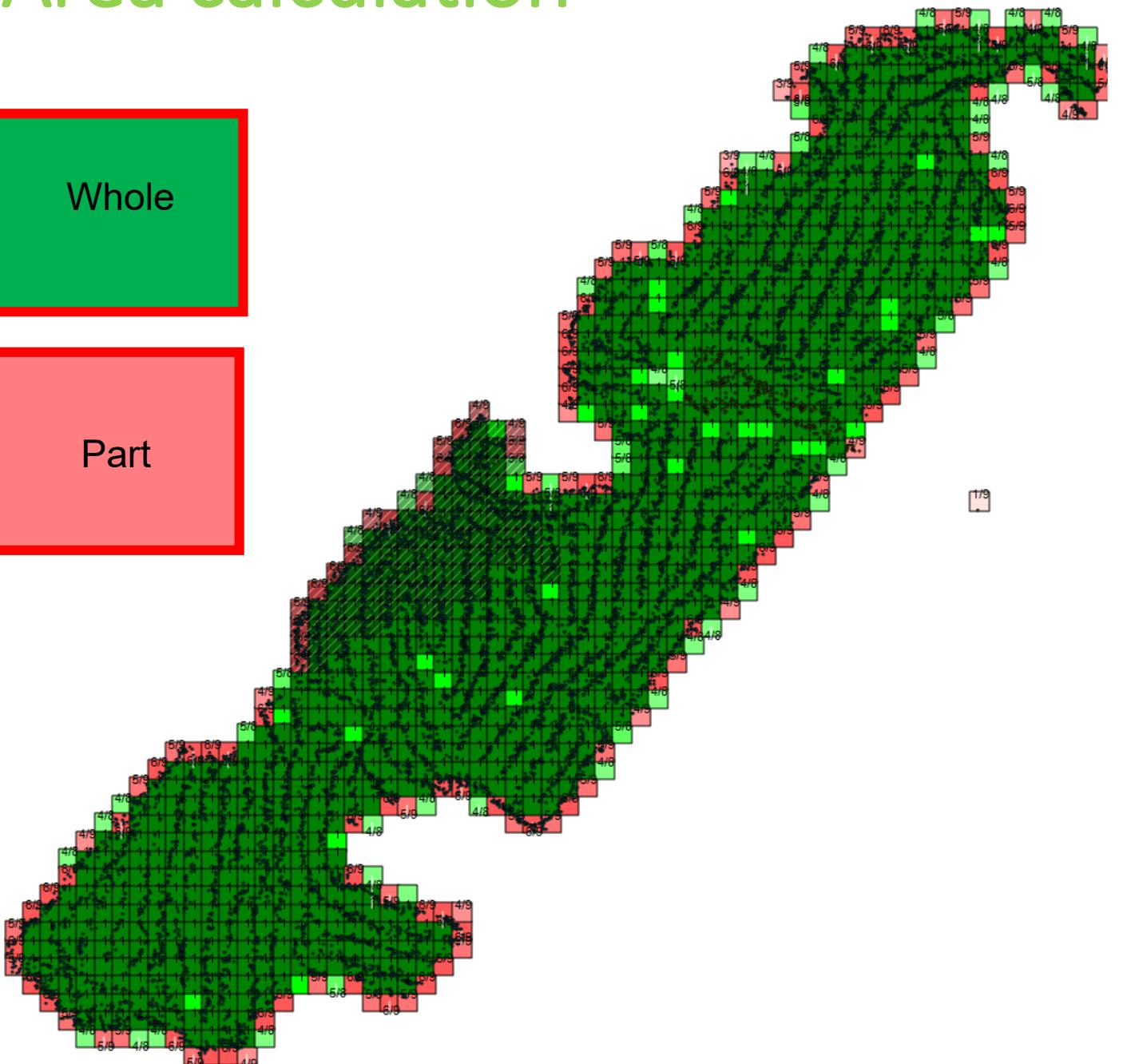
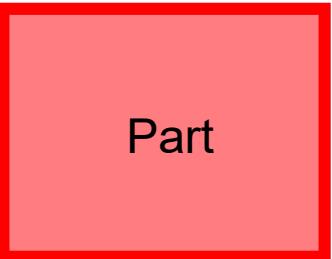
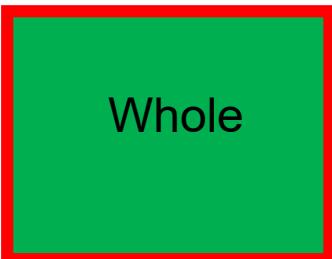


Cut tree



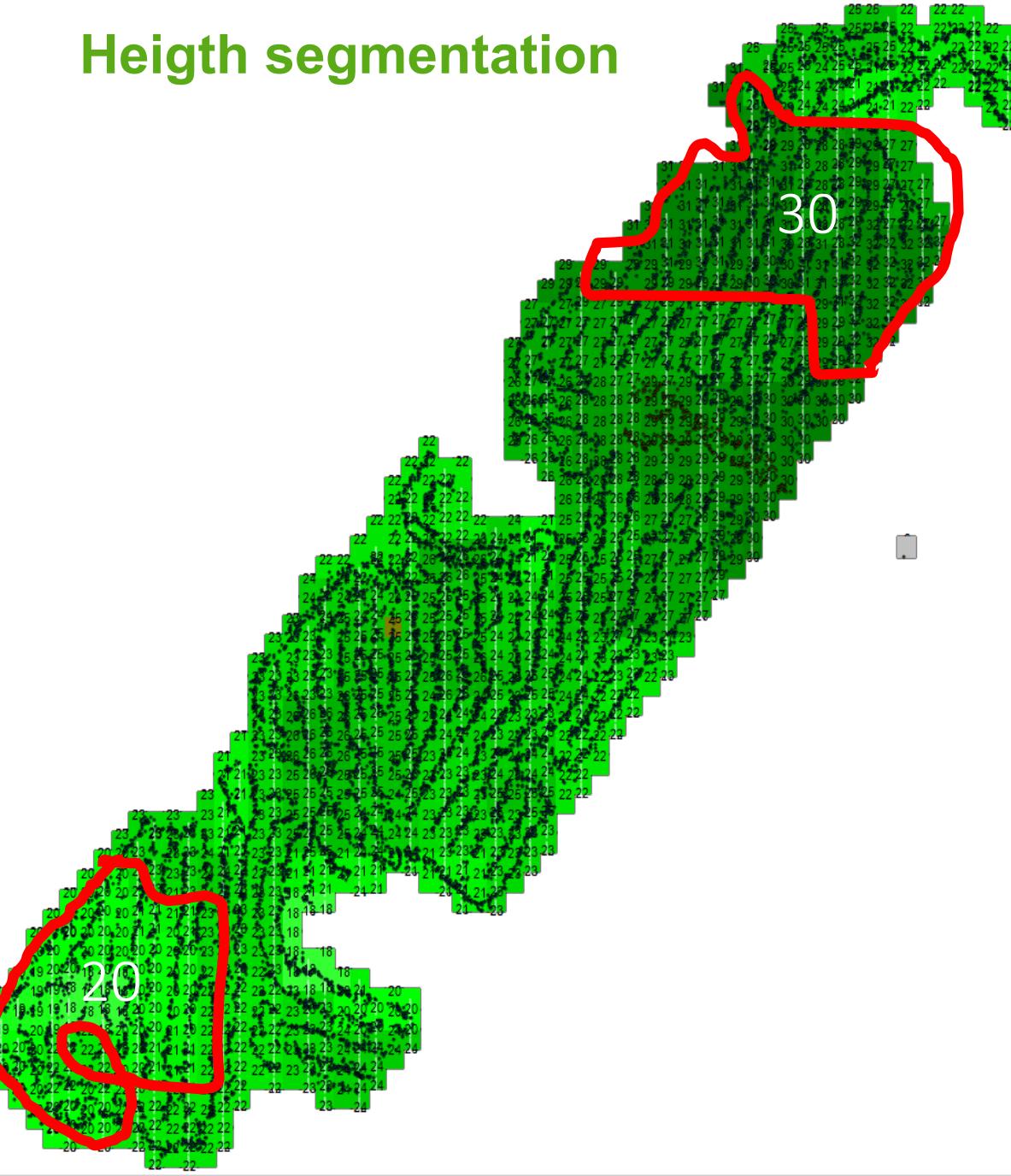


Area calculation

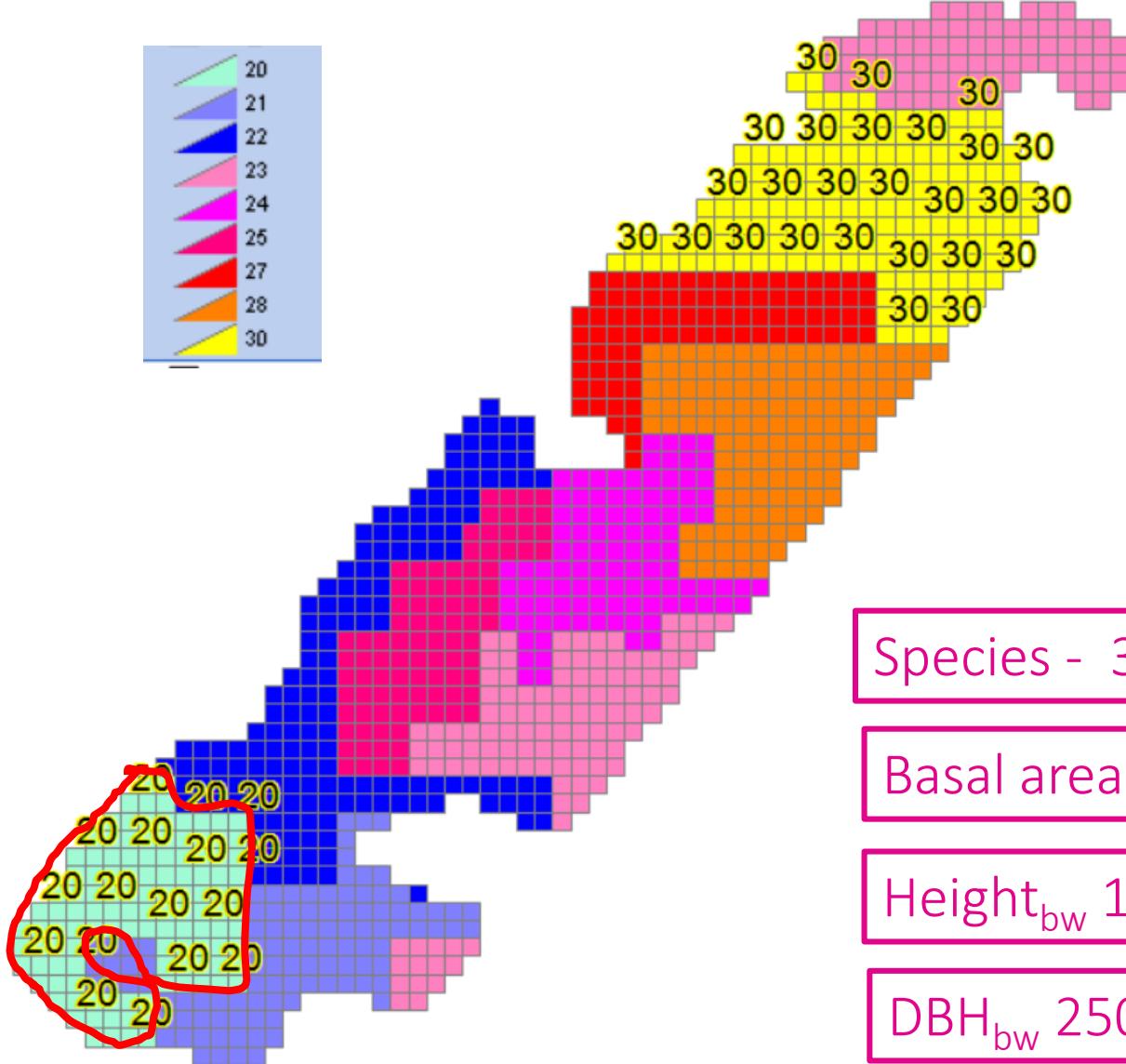




Heigth segmentation



Calculation area





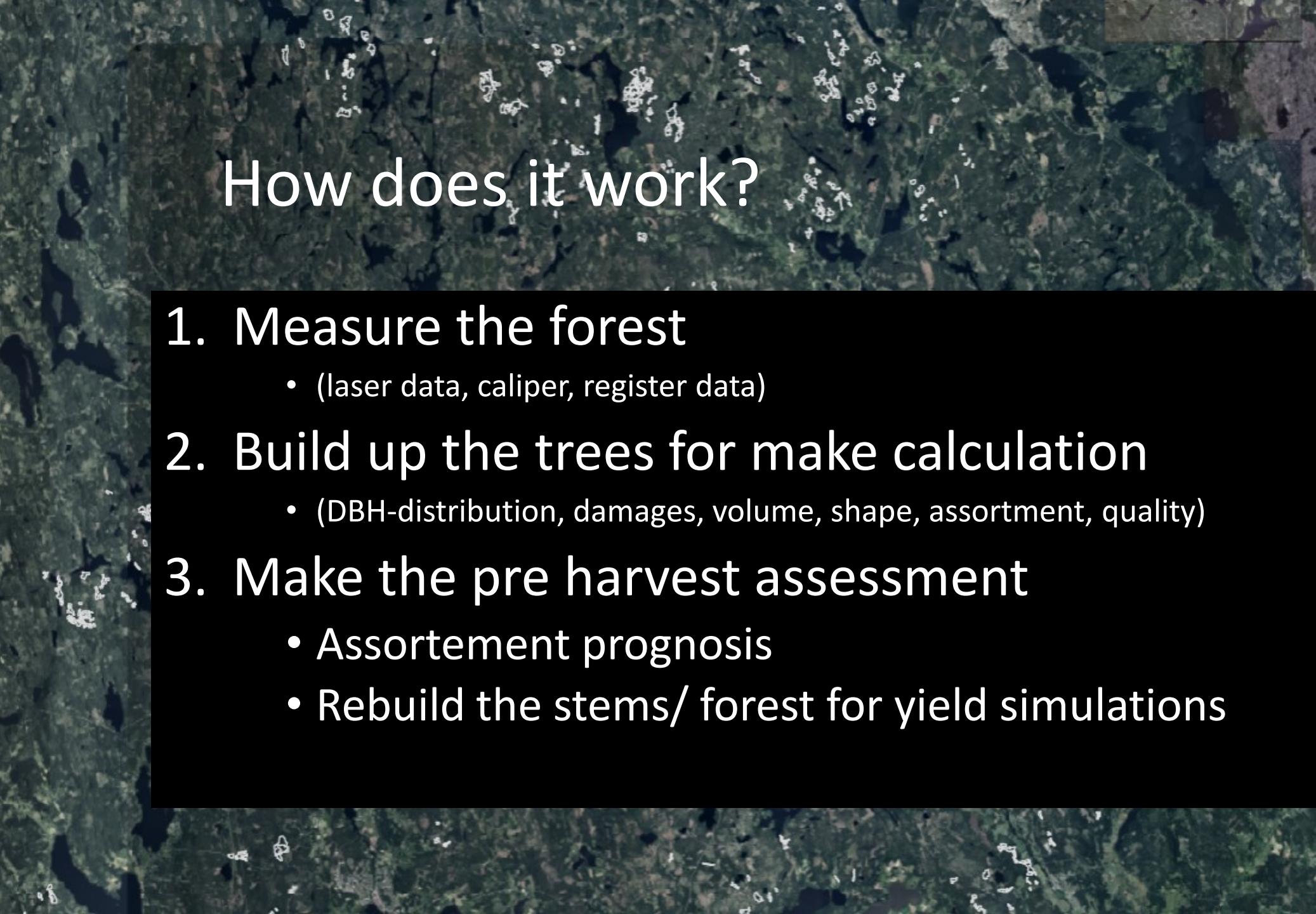
Database with
detailed harvesting
data



Pre-harvest assessment based on forest data and harvester information

How to forecast volumes and quality before harvesting?





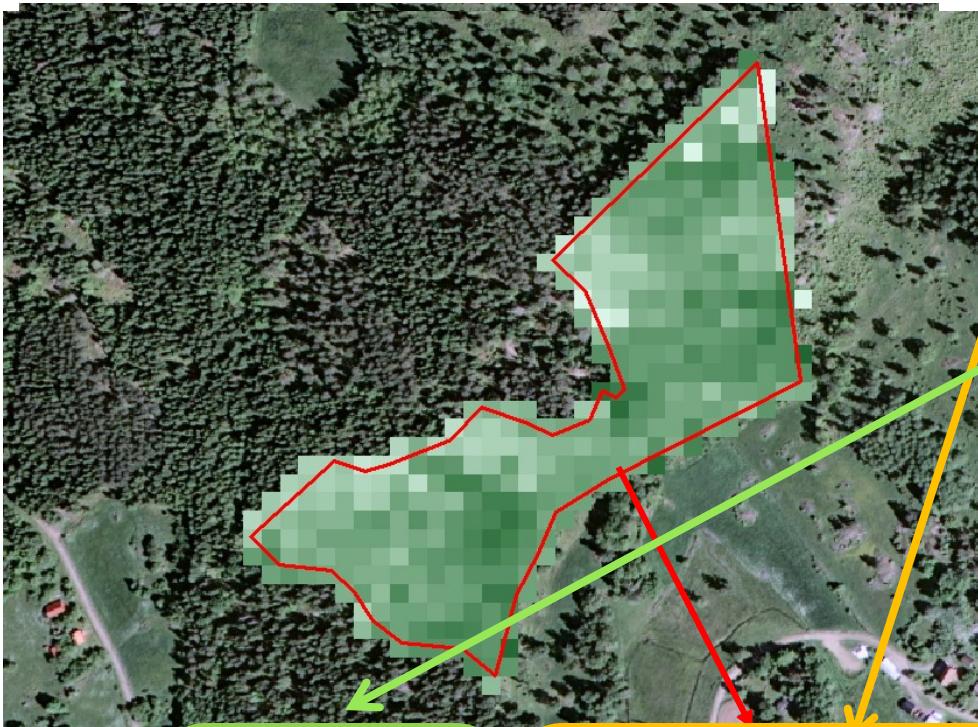
How does it work?

1. Measure the forest
 - (laser data, caliper, register data)
2. Build up the trees for make calculation
 - (DBH-distribution, damages, volume, shape, assortment, quality)
3. Make the pre harvest assessment
 - Assortement prognosis
 - Rebuild the stems/ forest for yield simulations

How does it work?

1. Measure the forest
 - (laser data, caliper, register data)
 2. Build up the trees for yield calculation
 - (DBH-distribution, damage, species, shape, assortment, quality)
 3. Made the yield prognosis
 - Yield prediction
 - Rebuild tree stems/ forest for yield simulations
- Harvester data

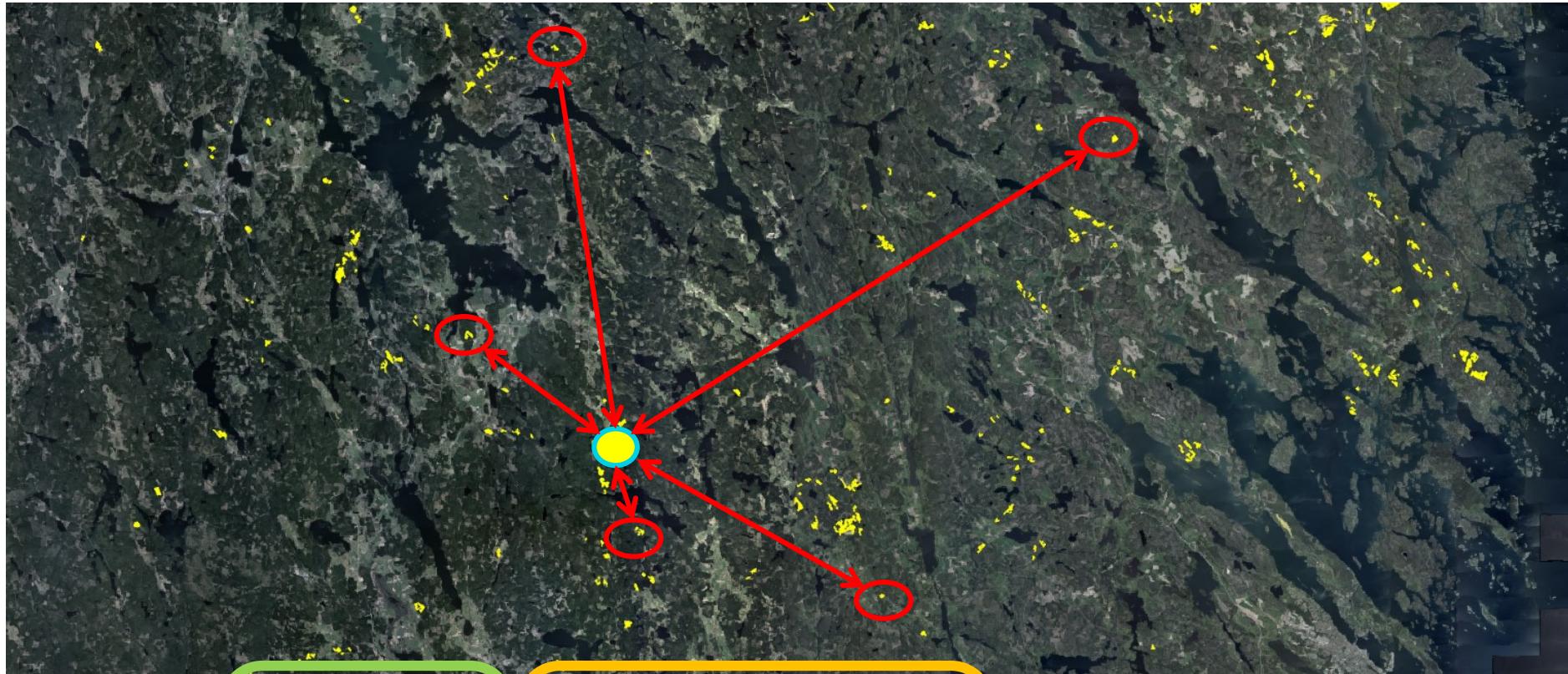
Planned harvesting site



- National ALS or manual inventory
 - Basel area, height, DB
- Manual inventory
 - Species

	Pine	Spruce	Basal area	Height	DBH	Pine saw logs	Pine Pulp wood	Spruce saw logs	Spruce Pulp wood	
— Harvesting site	4	88	33,0	23,4	30,6	?	?	?	?	xogforsk

Imputation



Planned	Pine	Spruce	Basal area	Height	DBH	Pine saw logs	Pine Pulp wood	Spruce saw logs	Spruce Pulp wood
—	4%	88%	33,0	23,4	30,6	?	?	?	?

Imputation

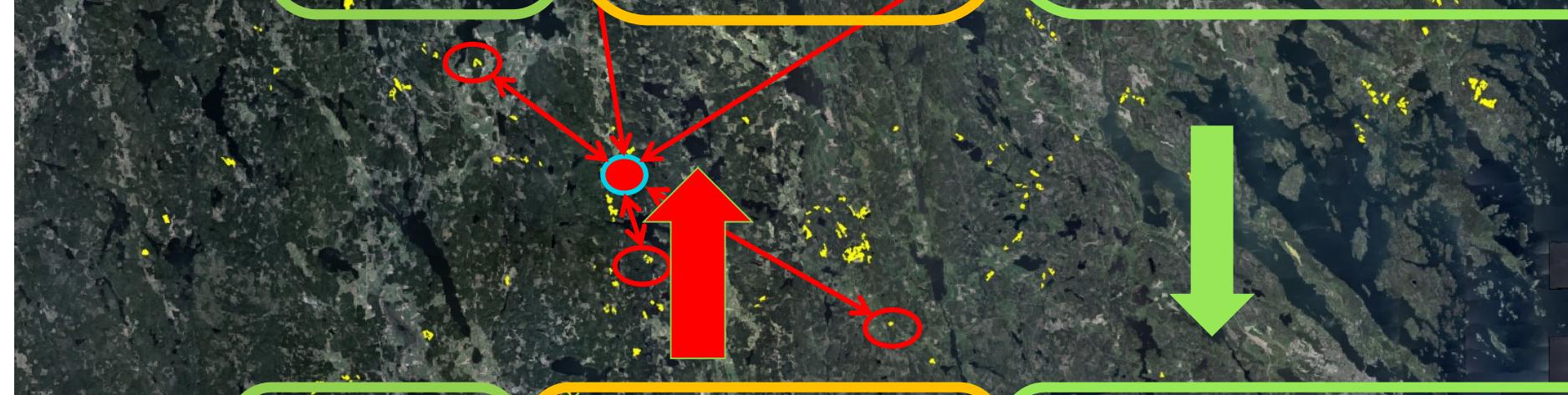
	Pine	Spruce	Basal area	Height	DBH	Pine saw log	Pine Pulp	Spruce saw log	Spruce Pulp
Harvested area 1	17%	81%	32,0	23,8	31,1	40	8	172	56
Harvested area 2	17%	82%	31,6	23,7	30,7	37	9	181	44
Harvested area 3	0%	97%	31,1	24,0	30,4	0	0	205	55
Harvested area 4	11%	85%	30,8	24,7	31,5	26	5	192	54
Harvested area 5	9%	90%	35,2	24,0	31,2	21	7	216	78



	Pine	Spruce	Basal area	Height	DBH	Pine saw logs	Pine Pulp wood	Spruce saw logs	Spruce Pulp wood
Planned	4%	88%	33,0	23,4	30,6	?	?	?	?

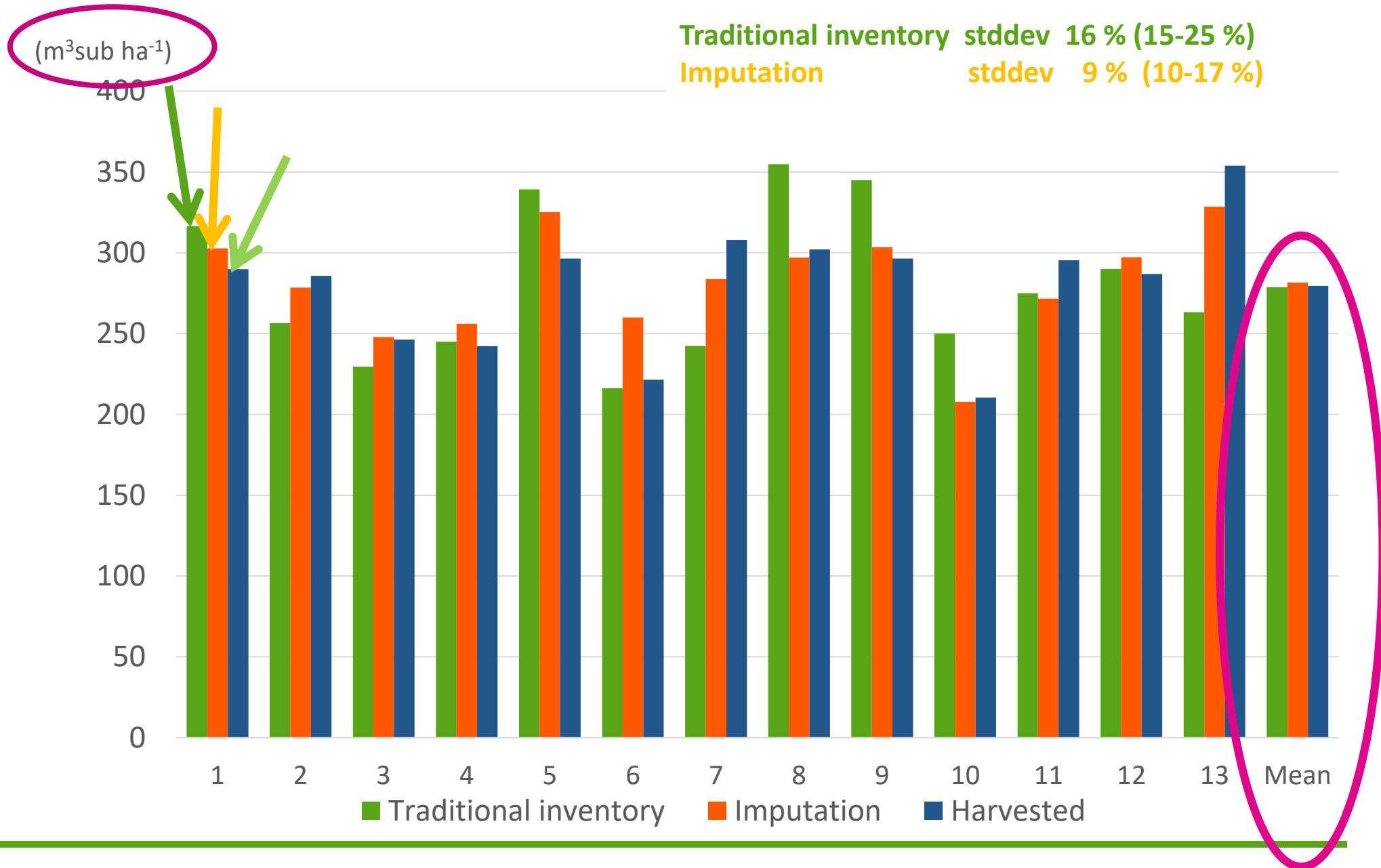
Pre-harvest assessment

	Pine	Spruce	Basal area	Height	DBH	Pine saw log	Pine Pulp	Spruce saw log	Spruce Pulp
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	Pine	Spruce	Basal area	Height	DBH	Pine saw logs	Pine Pulp wood	Spruce saw logs	Spruce Pulp wood
Planned	4%	88%	33,0	23,4	30,6	24,8	5,8	193,2	57,4

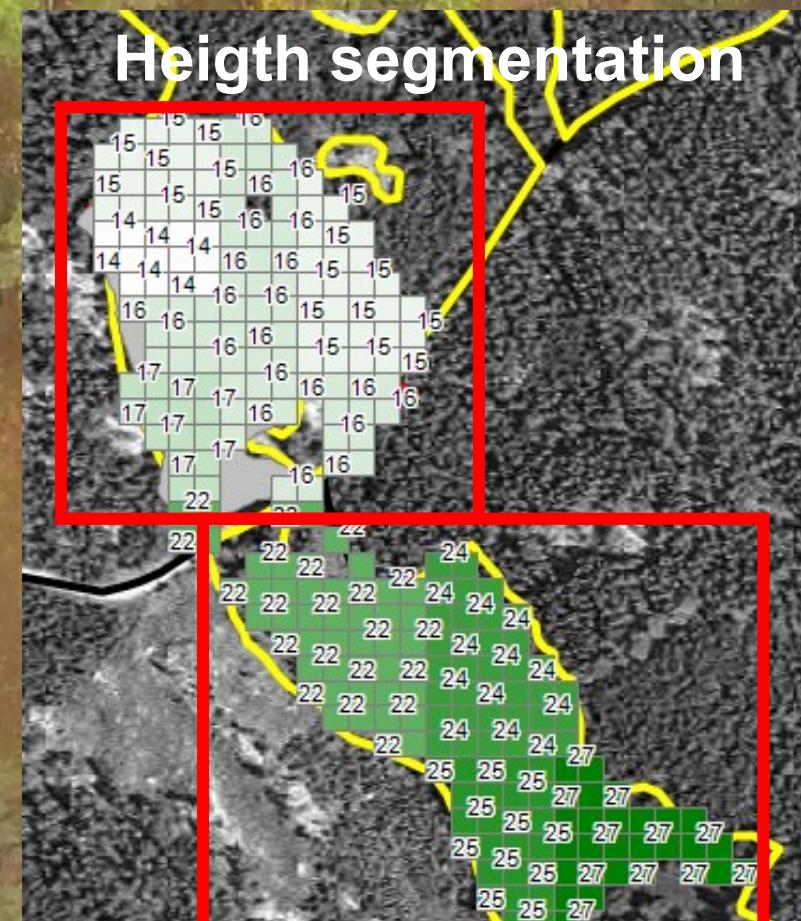
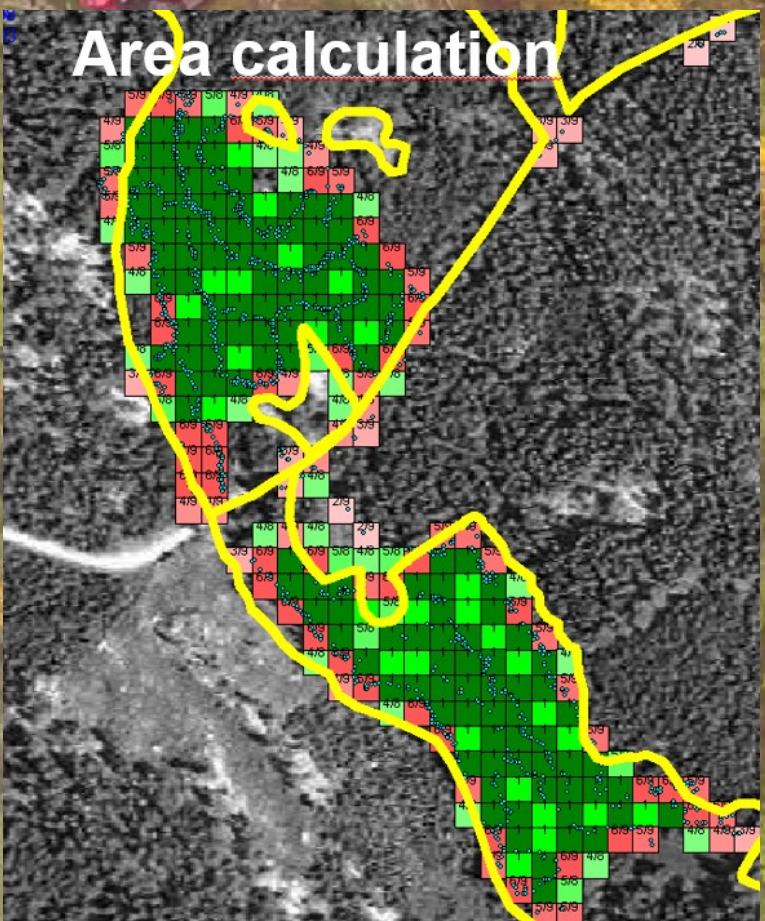
Results, total commercial volumes



An aerial photograph of a red harvester machine operating in a dense forest. The harvester has a long black boom extending upwards, which is used to reach and cut taller trees. The machine is positioned in a clearing or gap between several clusters of trees. The surrounding forest consists of various tree species, with many showing autumnal colors like yellow and orange, while others remain green. The ground appears to be covered in fallen branches and debris from previous operations.

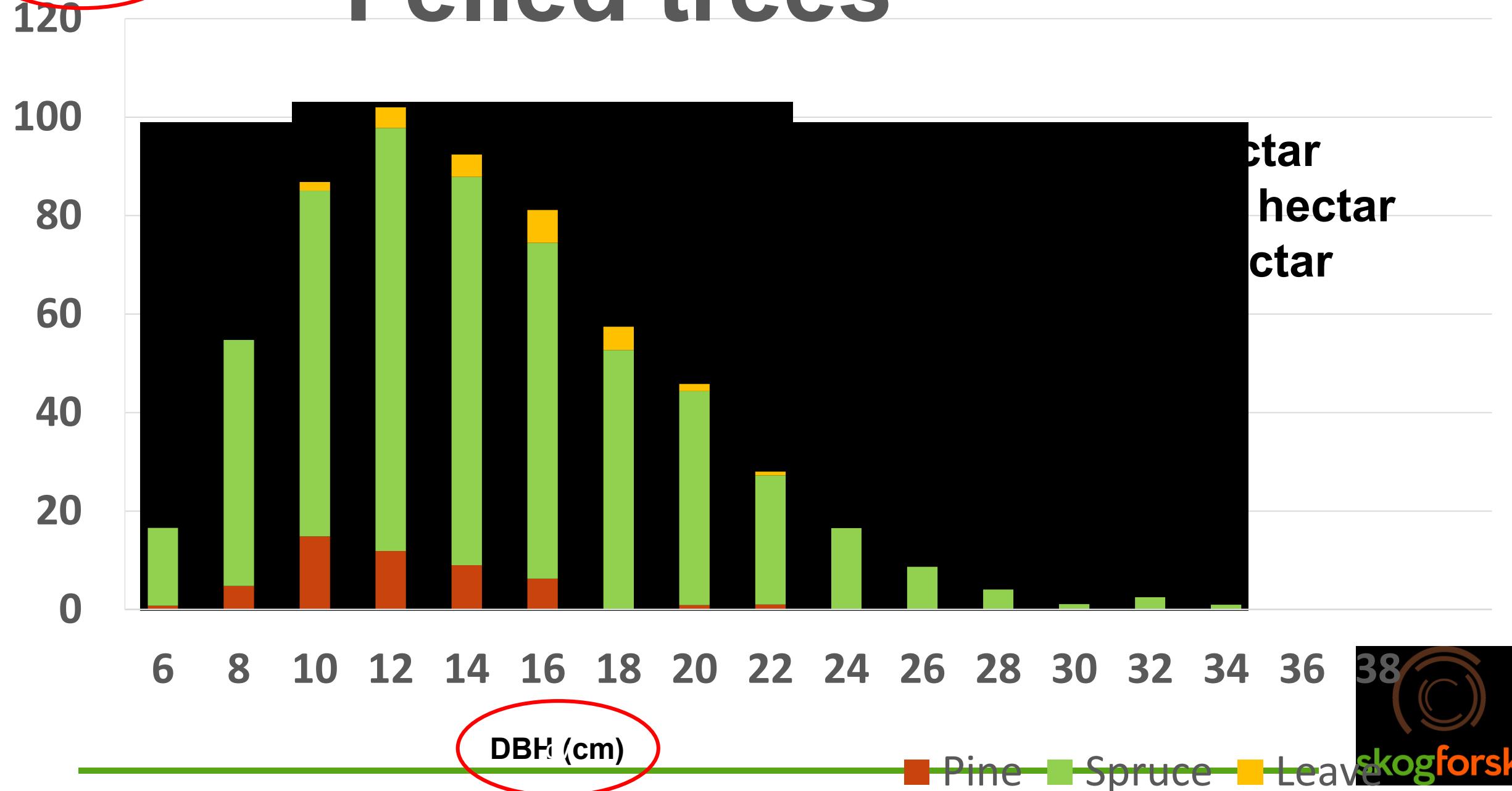
Estimating thinning results based on
standardized harvester data

Forest is re-created.....
or the felled forest....



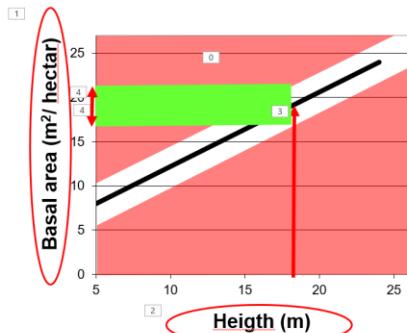
Trees (no)

Felled trees



2. Model - calculation of stand data after thinning

1. Decide the allowed basal area per hectar according to **statistics**



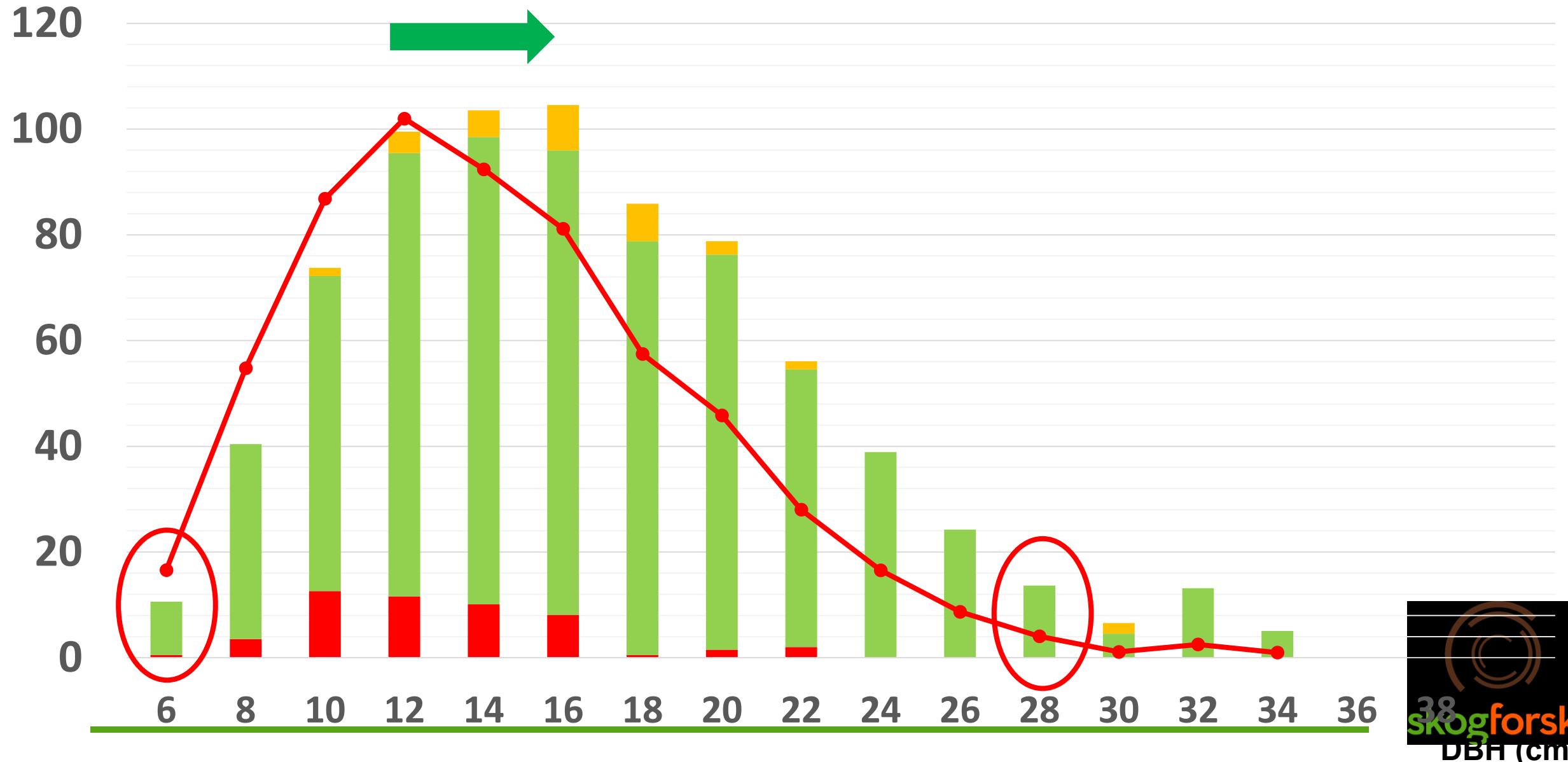
2. Calculating share of cutting per DBH according to **thinning quotient**



3. Calculating **key figure** for remaining stand after thinning

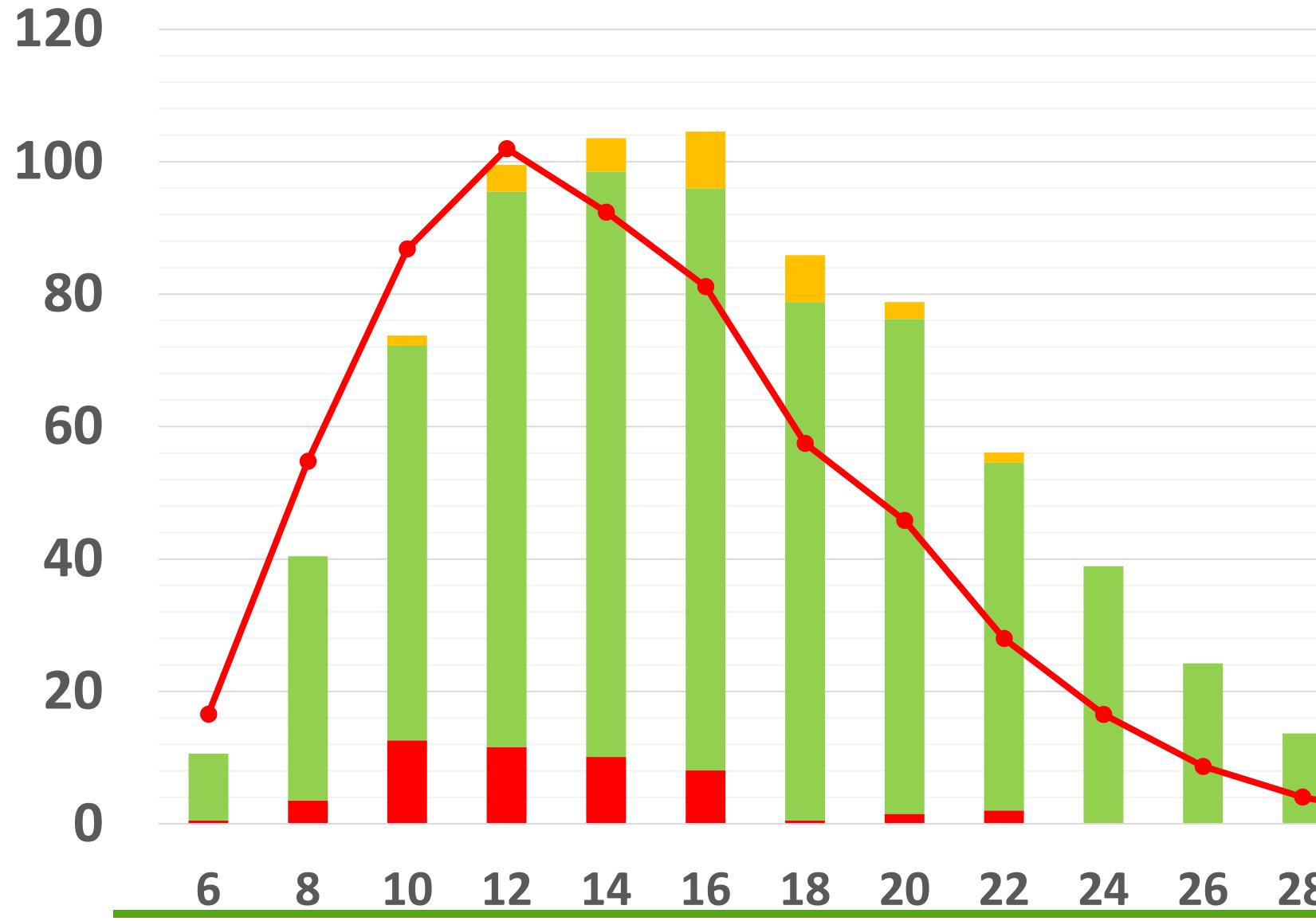
Trees (no)

Prognosis after thinning

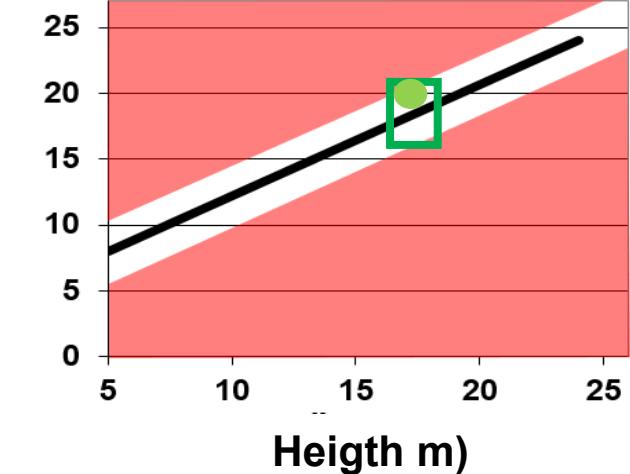


Trees (no)

Prognosis after thinning



Basal area (m^2/hectar)



20,2 m^2/hectar
761 stems/ hektar
130 m^3/hectar

Study

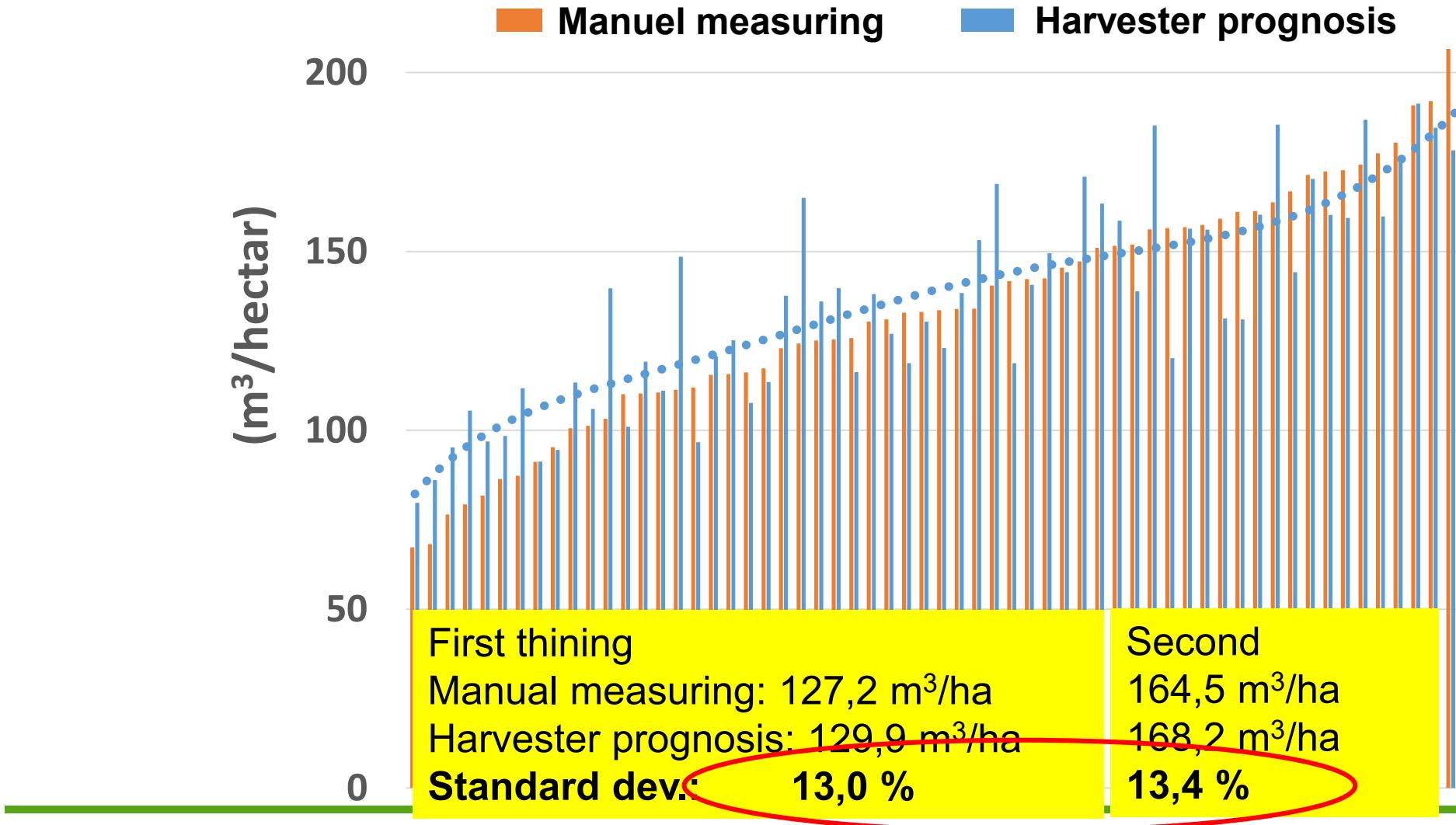
Manual reference measurements



Harvester data



Volume after thinning



- Infrastructure established
 - All harvester collect data, airborne laser scanned forest
- Models established – good result from practical tests
- First company systems is today working
- Many possible ways of further development.....