How could data from harvesters be used for future planning?

SLU Alnarp februari 2019

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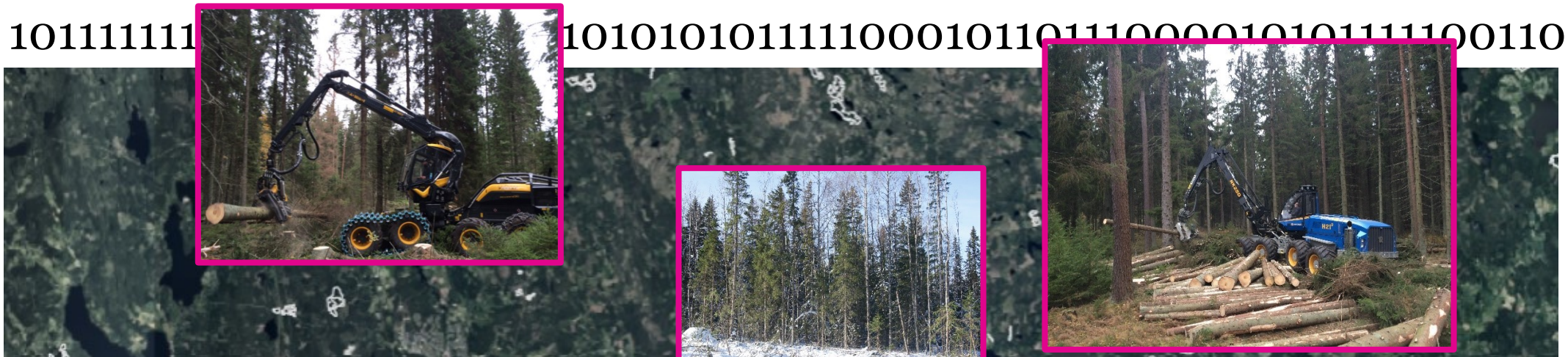
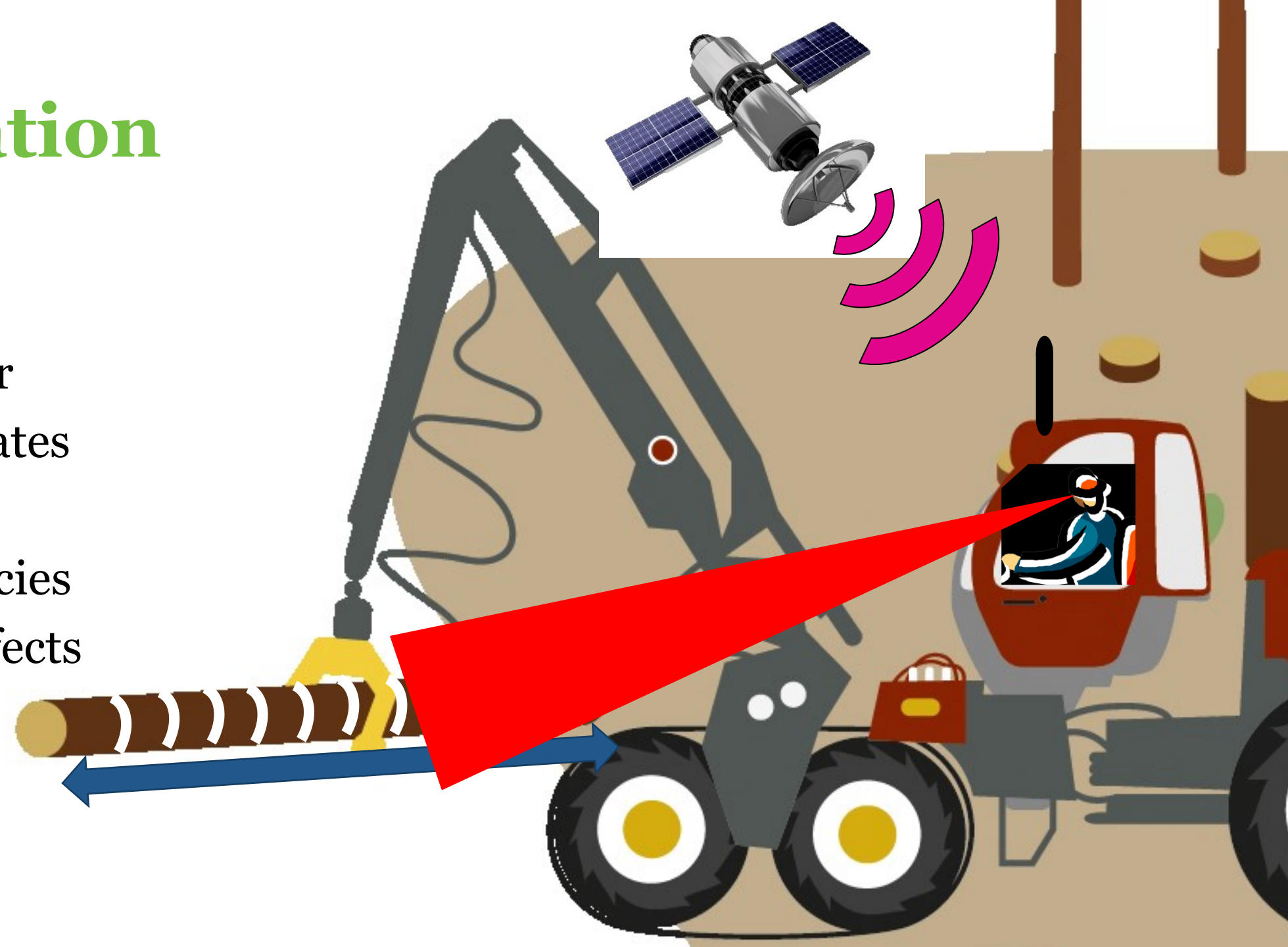


Registration

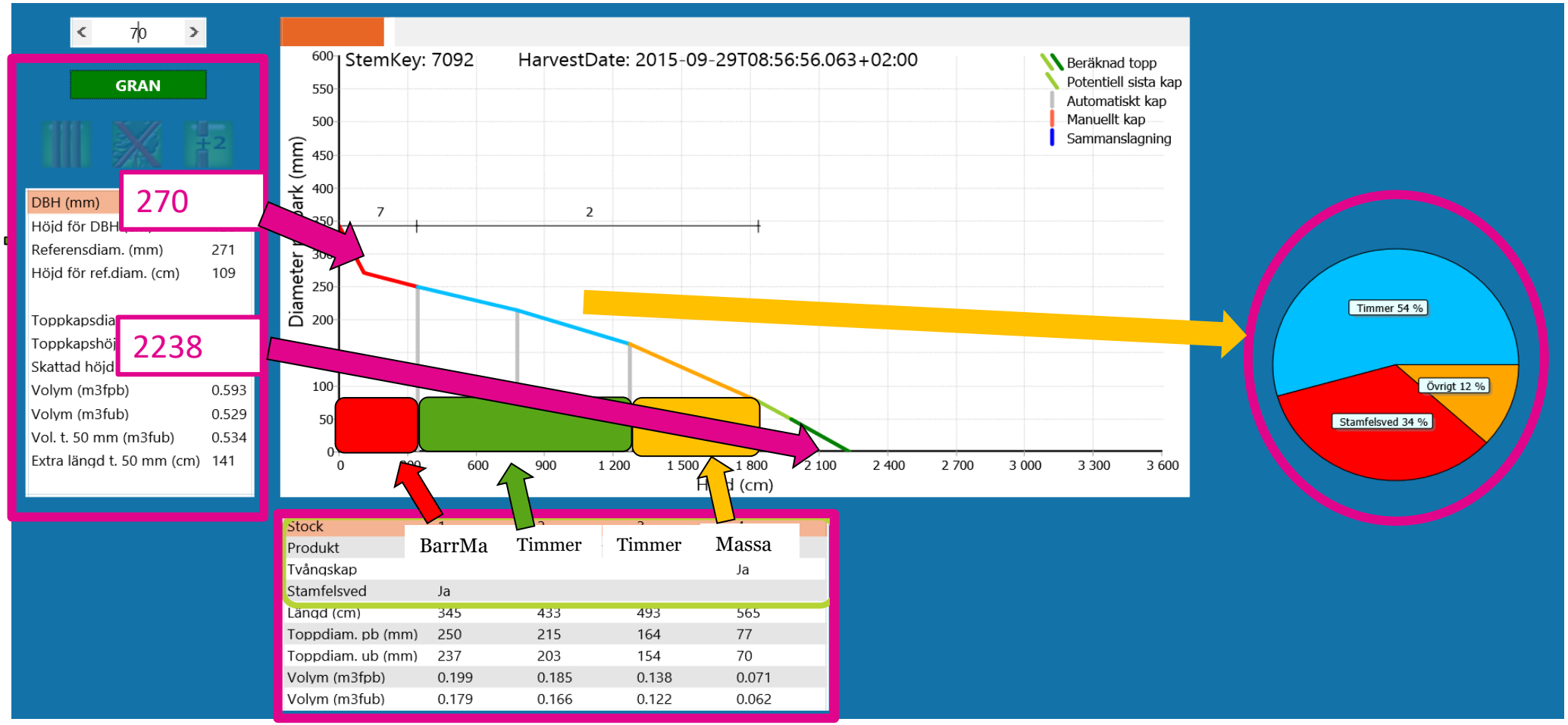
Length
Diameter
Coordinates

Tree species
Stem defects

Quality

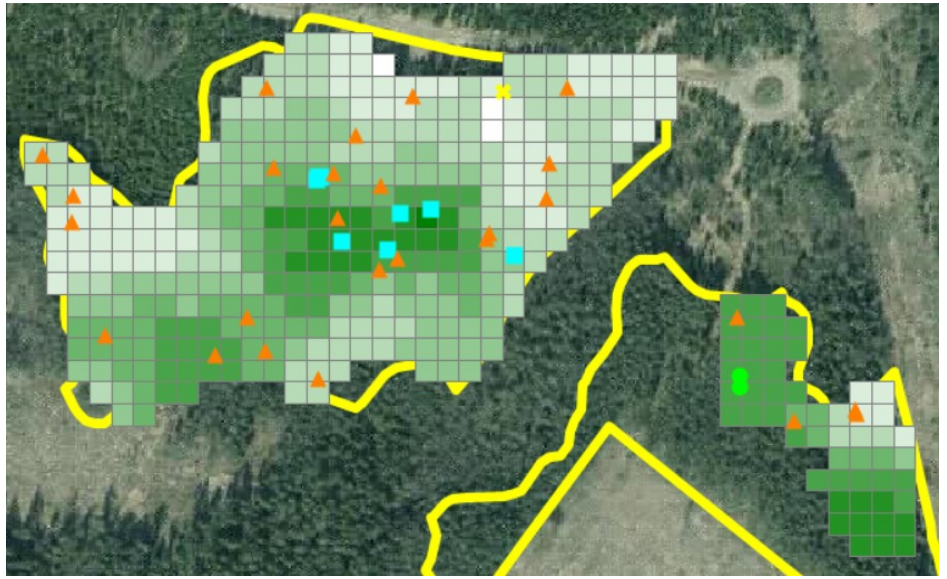


Harvester data - hpr



Registration of considerations

- Registration during harvesting (incl StanForD codes)
- Considerations taken
- Further use on the “digital forestry chain” as well as sustainability reporting



Ladda kartbild | Ladda gränser | » Avancerade inställningar

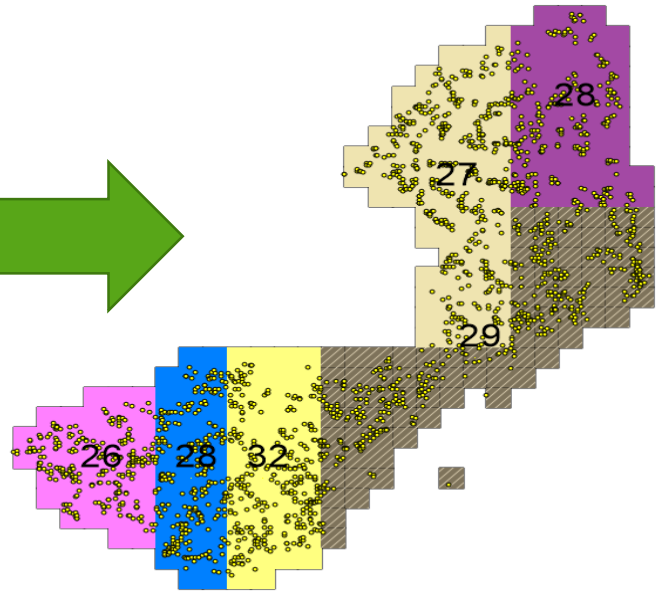
Visa naturvårdshänsyn i tabell | per hektar

	Totalt	Tall	Gran	Björk	Contorta	Övrig
Antal högstubbar (st)	26	11	10	5		
Antal kulturstubbar (st)	8					
Antal evighetsträd (st)	1					
Antal trädgrupper (st)	2					

Identify the variation in forests – microcompartments from harvester data

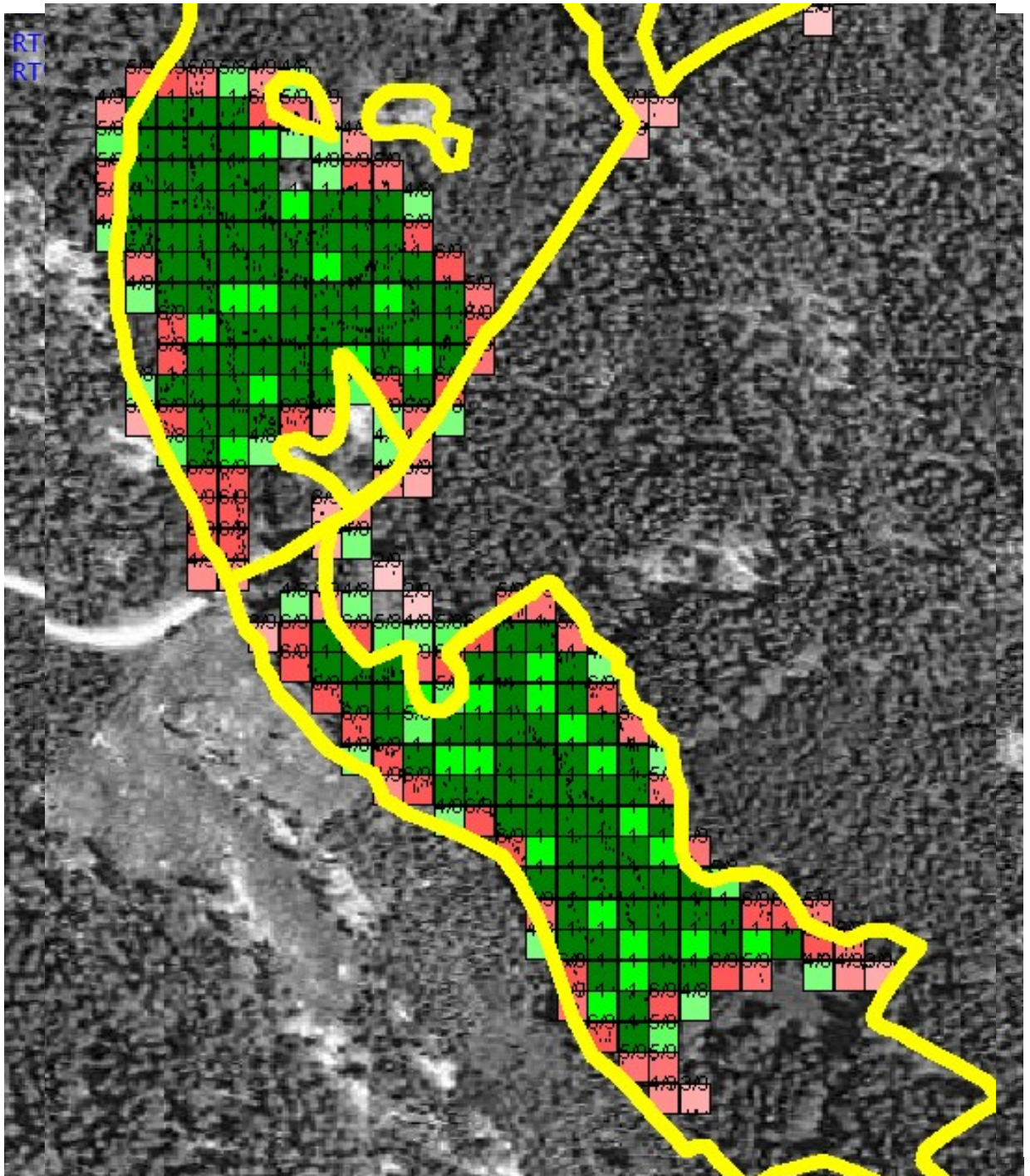
1. Harvester data (harvester production files, *.hpr)
2. Sorted by contract number
3. Hpr Calculation Modele (hprCM) to calculate tree heights

1. Area calculation
2. Split to microcompartments based on upper height (0,5-2 hectares)



Follow up on thinnings

- Thinning ratio
  - Mean diameter of harvested trees/mean diameter of remaining trees – (normally 0,8-0,9; 0,9-0,95 in strip roads)
- Strength of thinning
  - Proportion of thinned basal area or forest volume (normally 20-40 %)
- Lots of statistics available as normally you remove 30-45% of all trees in thinning



Avverkad areal: 3.79 ha

st/ha | m3fub/ha | m2/ha
st | m3fub | sista kap

Uttag totalt:
60.9 m3fub/ha

Löpande uttag:

Visa prognosytor | Visa ÖH

Prognosytor: uttag | kvarvarande skog

Prognos aktuell yta:
39.5 m3fub/ha

Prognosytor totalt:
60.6 m3fub/ha

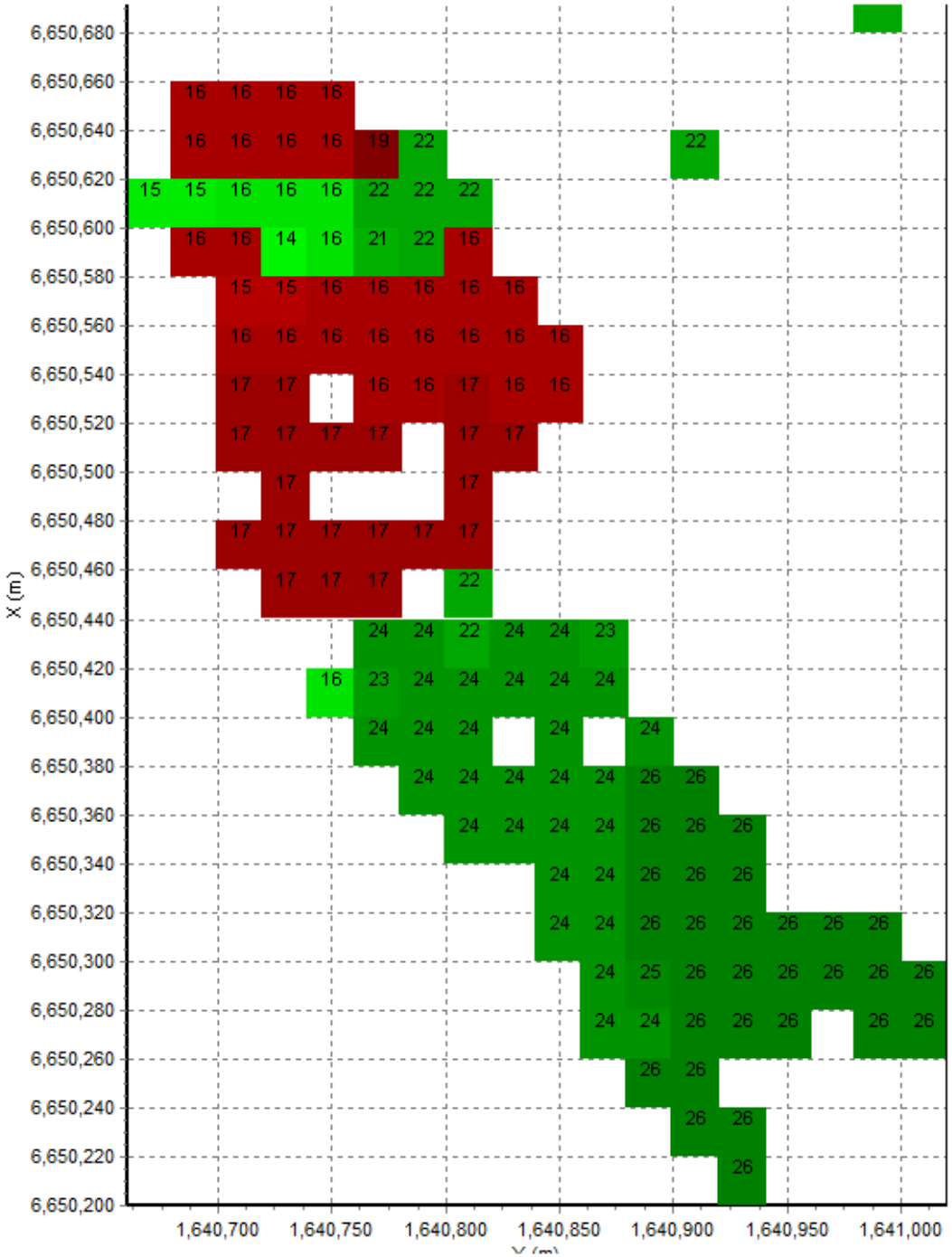
Prognos för vald yta

Beskrivning av uttag:
Areal: 3.76 ha
ÖH: 19 m
GY: 8.3 m2/ha
DGV: 186 mm
HGV: 18 m
TGL:

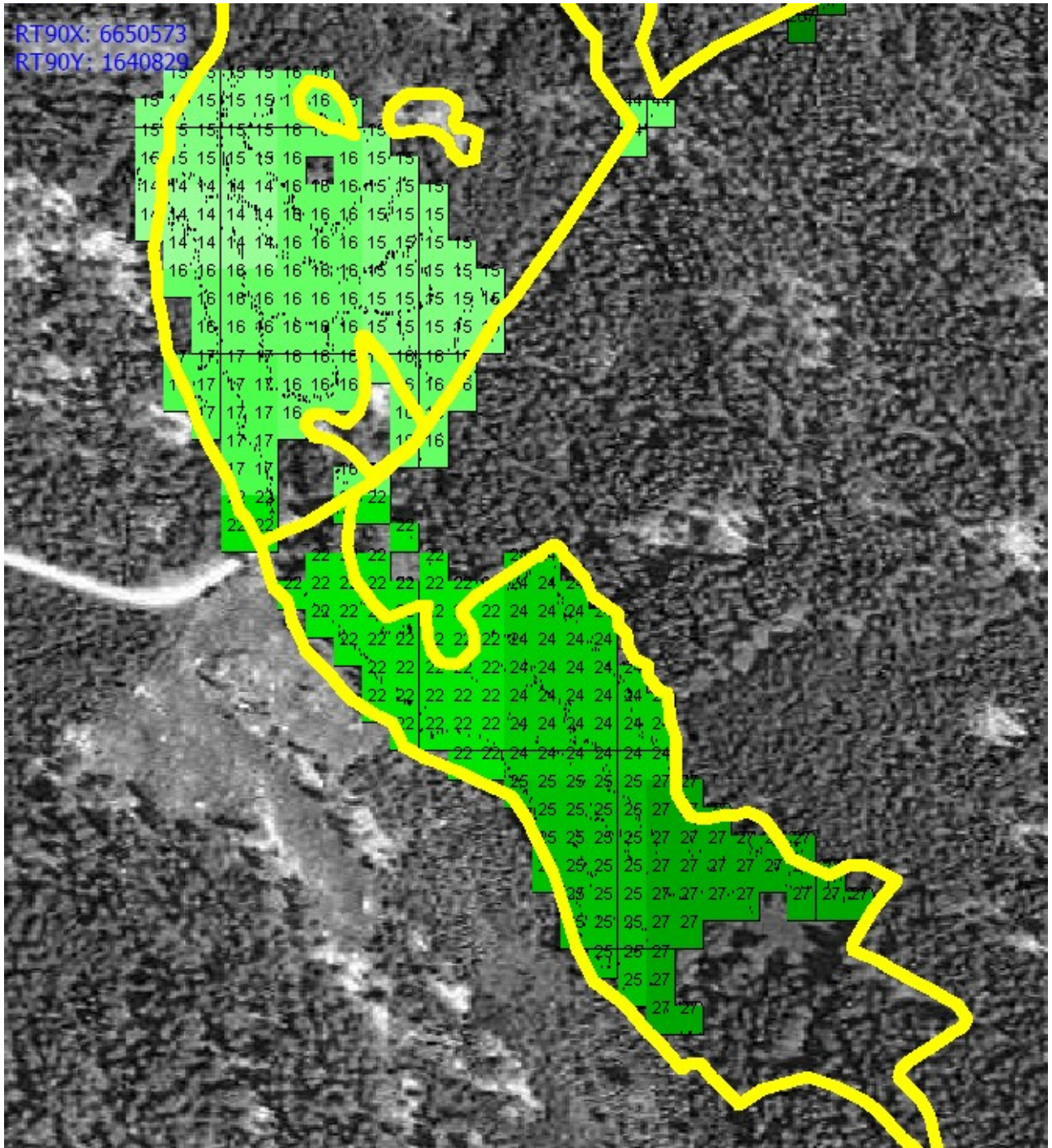
Prognos för kvarvarande skog:
Gallringsstyrkan blev 27 %.

Aktuell gallringsstyrka ger grundyta efter gallring 22.6 m2/ha, vilken ligger inom angivna gränser.

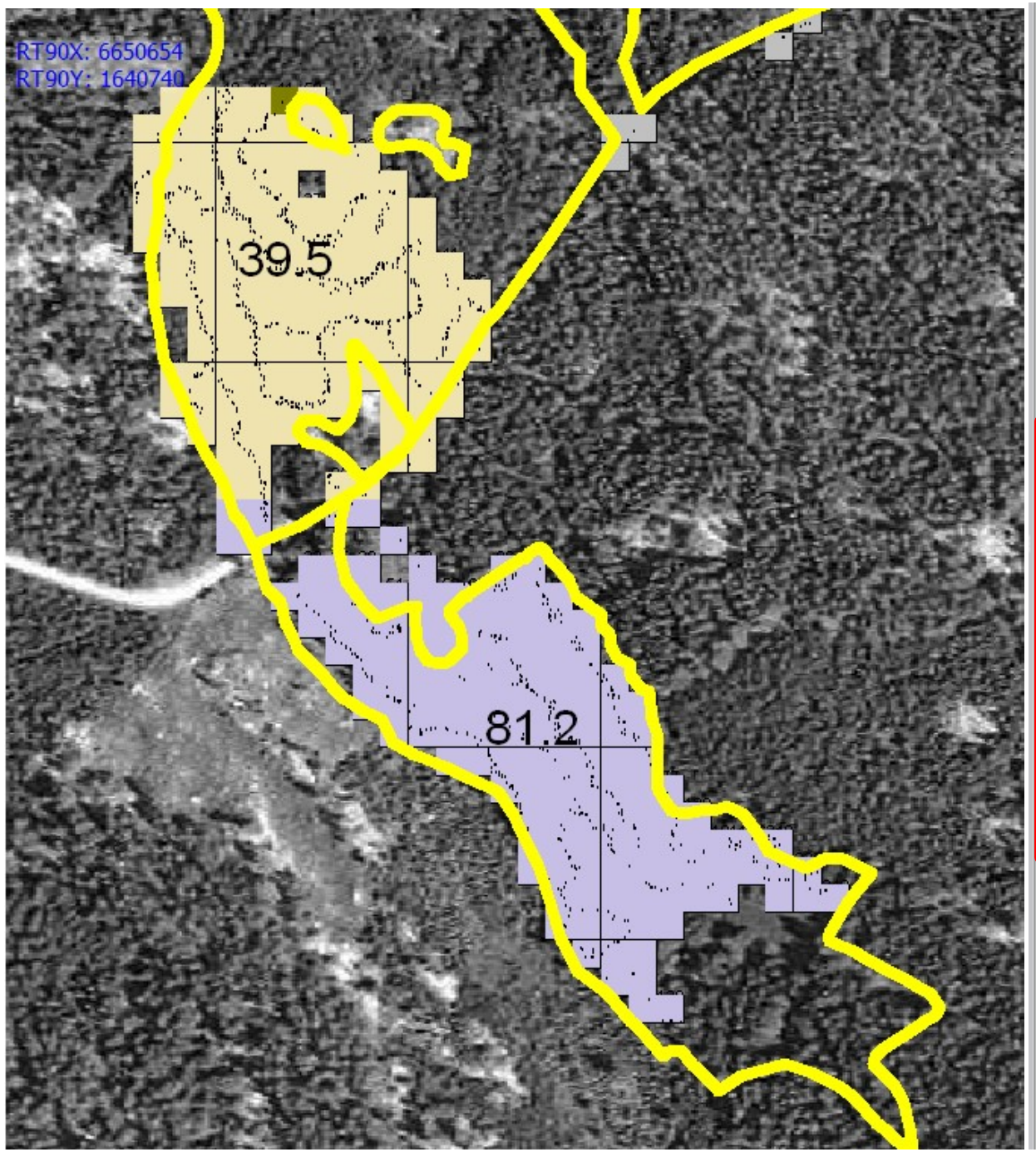
Total för prognosytor



1. Bestäm trädslag och ÖH



2. Dela objektet efter ÖH



Avverkad areal: 3.79 ha

st/ha | m3fub/ha | m3 | st | m3fub | sista kap

Uttag totalt:
60.9 m3fub/ha

Löpande uttag:

Visa prognosytor | Visa ÖH

Prognosytor: uttag | kvarvarande skog

Prognos aktuell yta:
39.5 m3fub/ha

Prognosytor totalt:
60.6 m3fub/ha

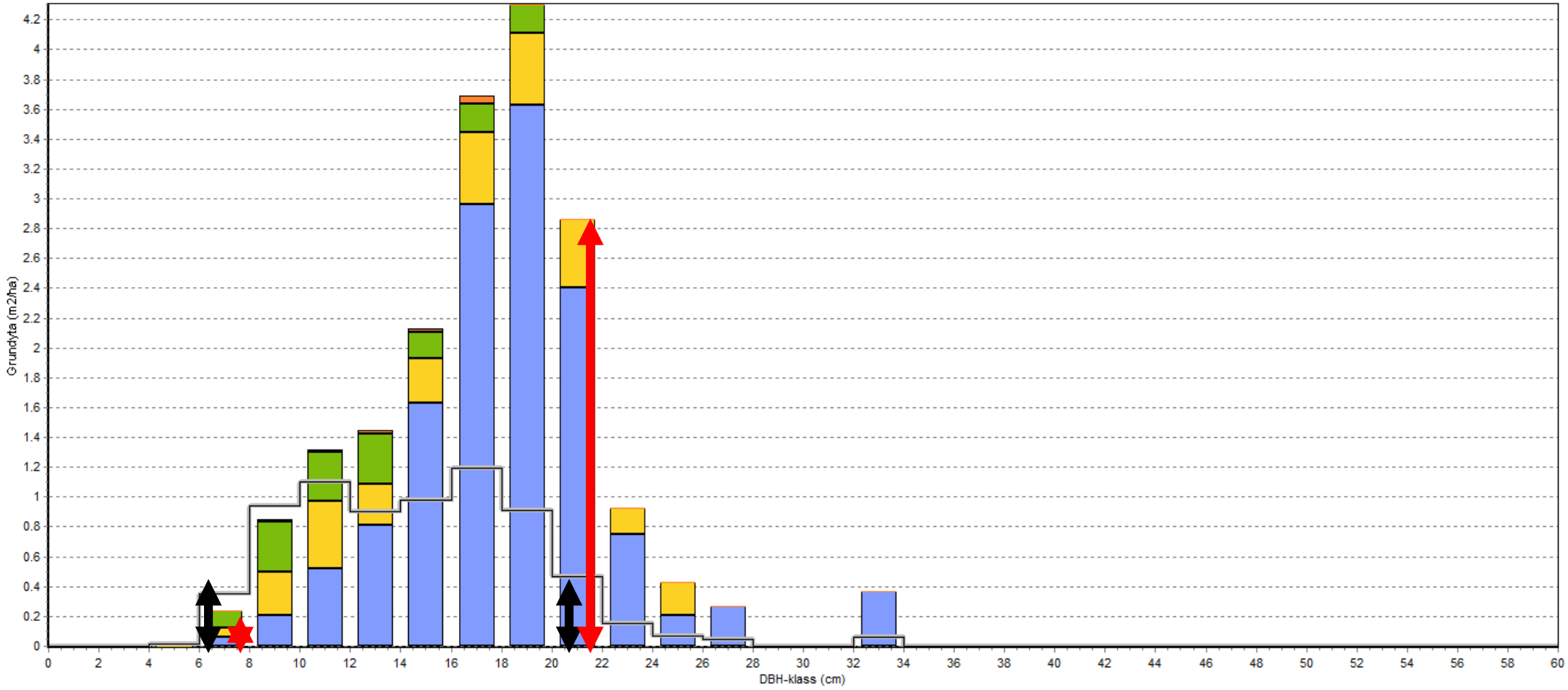
Prognos för vald yta

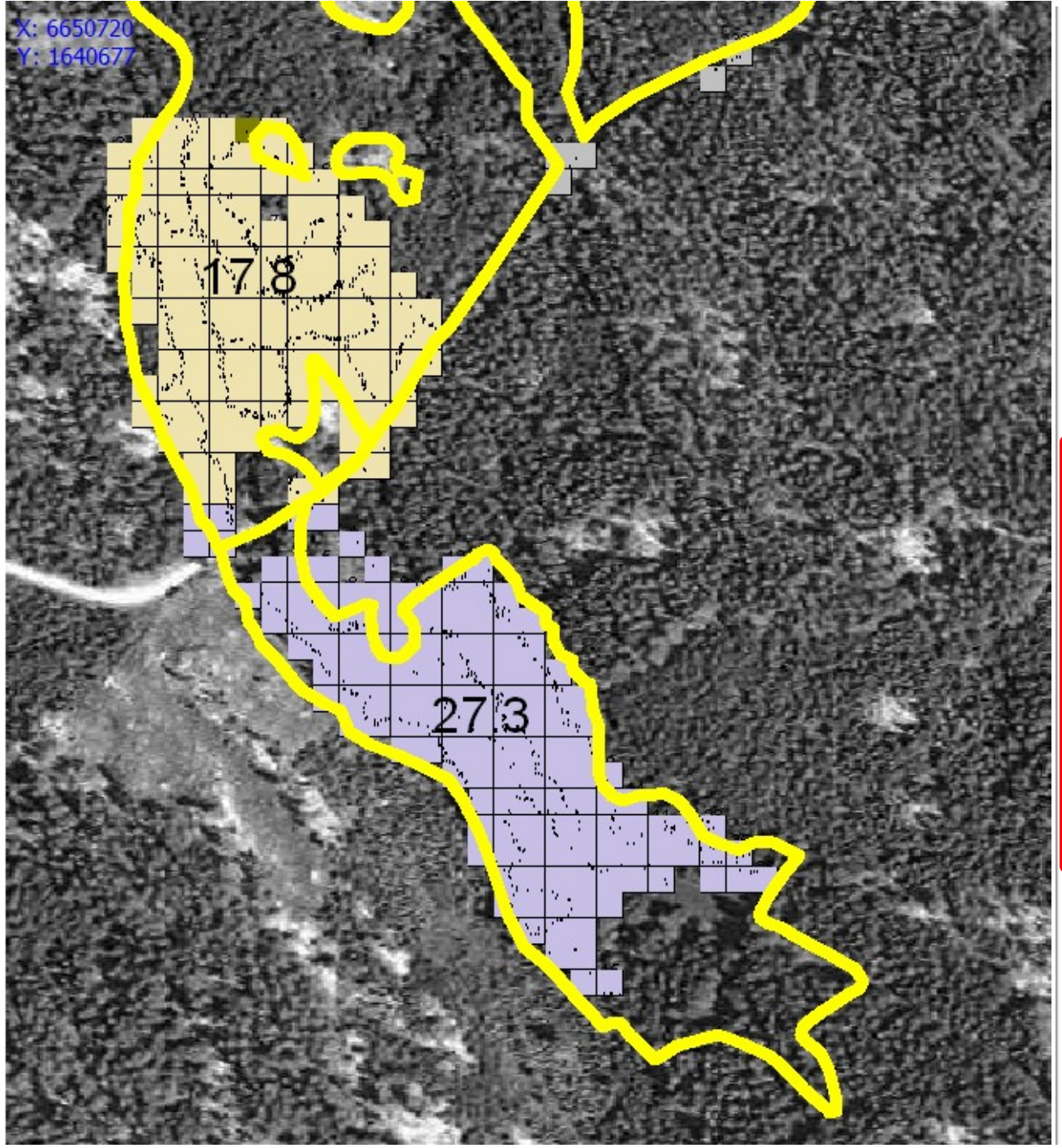
Beskrivning av uttag:
Areal: 1.86 ha
ÖH: 16 m
GY: 6.9 m2/ha
DGV: 143 mm
HGV: 13 m
TGL:

Prognos för kvarvarande skog:
I beräkningarna har gallringskvot 0.8 och gallringsstyrka 28 % använts.
Aktuell gallringsstyrka ger grundyta efter gallring 17.8 m2/ha, vilken ligger inom angivna gränser.

Total för prognosytor

Prognosis of the remaining forest





Avverkad areal: 3.79 ha

st/ha m3fub/ha m2/ha
st m3fub sista kap

Uttag totalt:
8.4 m2/ha

Löpande uttag:

Visa prognosytor Visa ÖH

Prognosytor:
uttag
kvarvarande skog

Prognos aktuell yta:
17.8 m2/ha

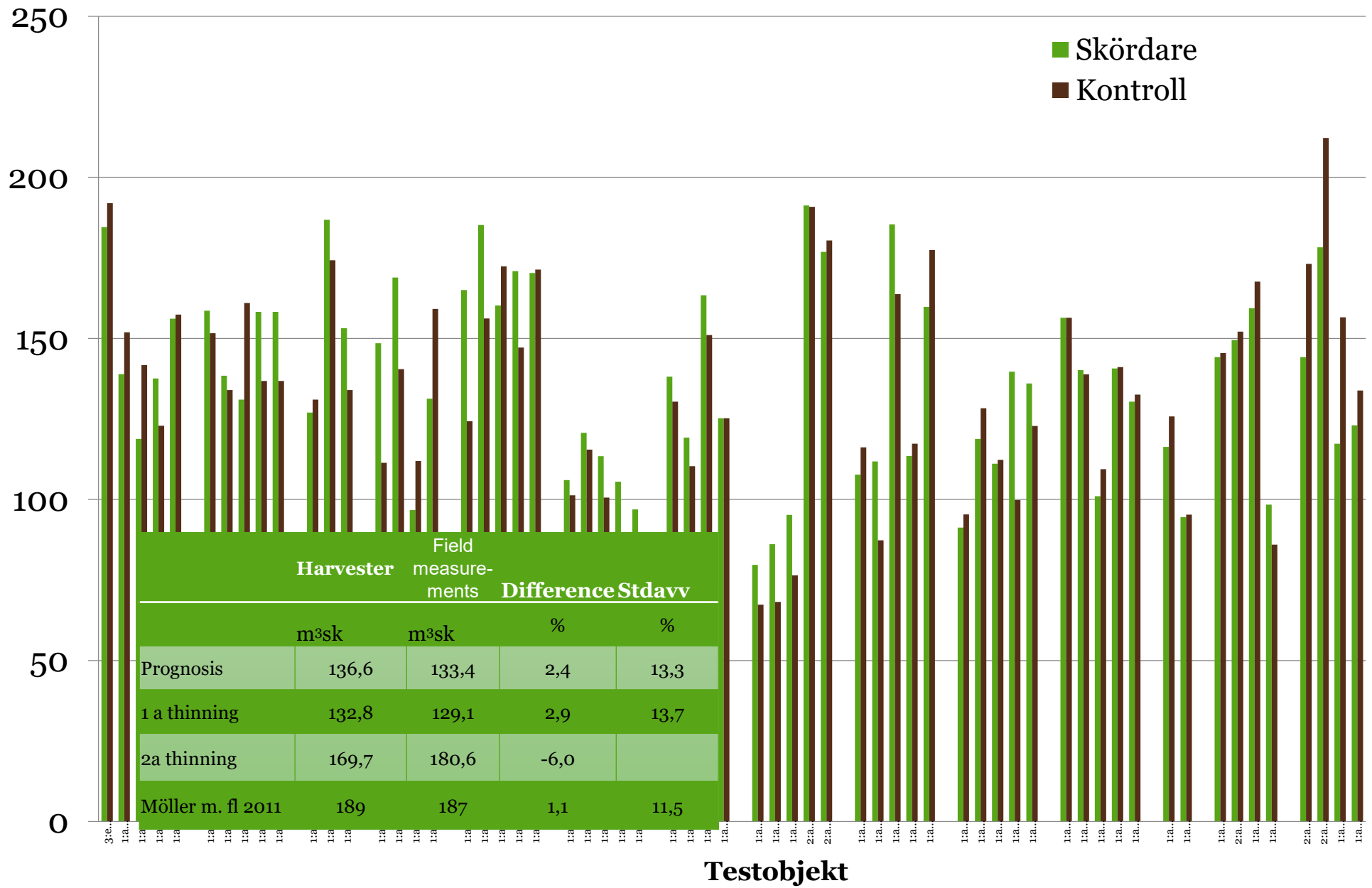
Prognosytor totalt:
22.6 m2/ha

Prognos för vald yta

Beskrivning av kvarvarande skog:
Areal: 1.86 ha
ÖH: 16 m
GY: 17.8 m2/ha
DGV: 178 mm
HGV: 15 m
TGL:

Prognos för kvarvarande skog:
I beräkningarna har gallringskvot 0.8 och gallringsstyrka 28 % använts.
Aktuell gallringsstyrka ger grundyta efter gallring 17.8 m2/ha, vilken ligger inom angivna gränser.

Volym after thinning

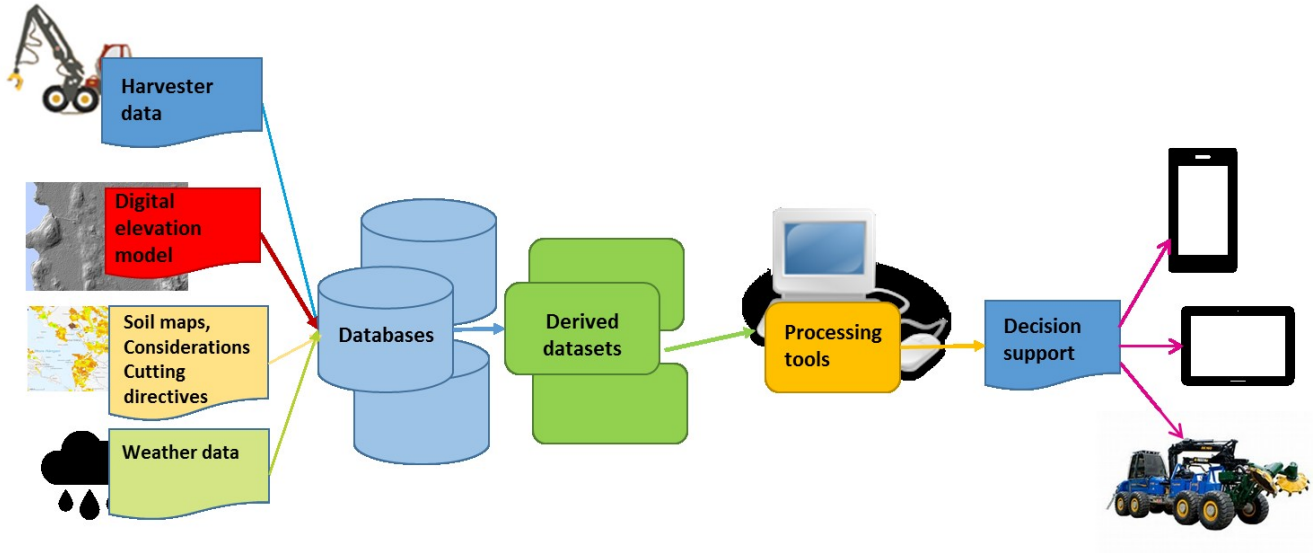


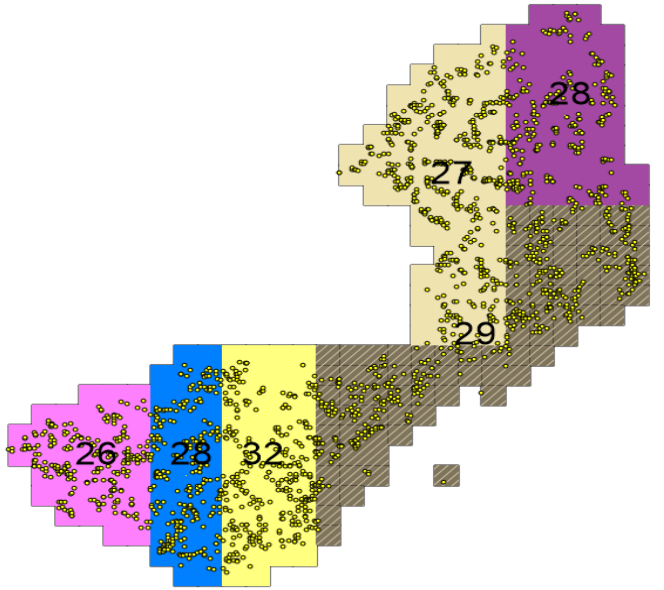
	Harvester	Field measure-ments	Difference	Stdavv
	m³sk	m³sk	%	%
Prognosis	136,6	133,4	2,4	13,3
1 a thinning	132,8	129,1	2,9	13,7
2a thinning	169,7	180,6	-6,0	
Möller m. fl 2011	189	187	1,1	11,5

Findings

- Large sample, 40-45 % of the tree
- Large variation in forests, microcompartments 0,5-1 ha
- Important with area calculation, divide into microcompartments!
- Results in line with new lidar estimates (similar estimation acuracy)

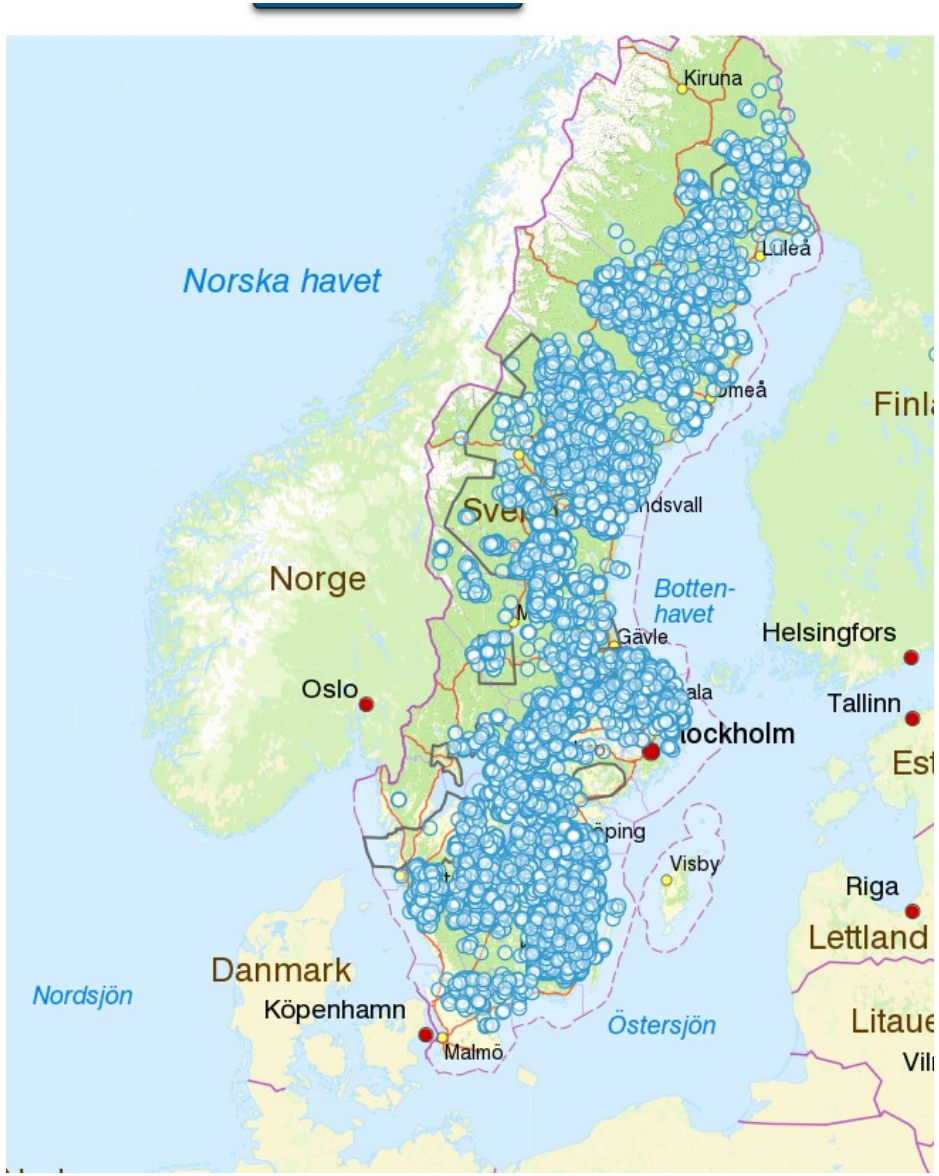
Harvester data for silviculture





Plantorder

- Based on harvester data
- Growth?
- Root rot frequence?
- Site index



Plantbeställning

Virkesordernummer

Ålder

80

Visa områden med höjddata

Hämta objekt

Avverkat 2015-07-29

Tallar | granar per ha

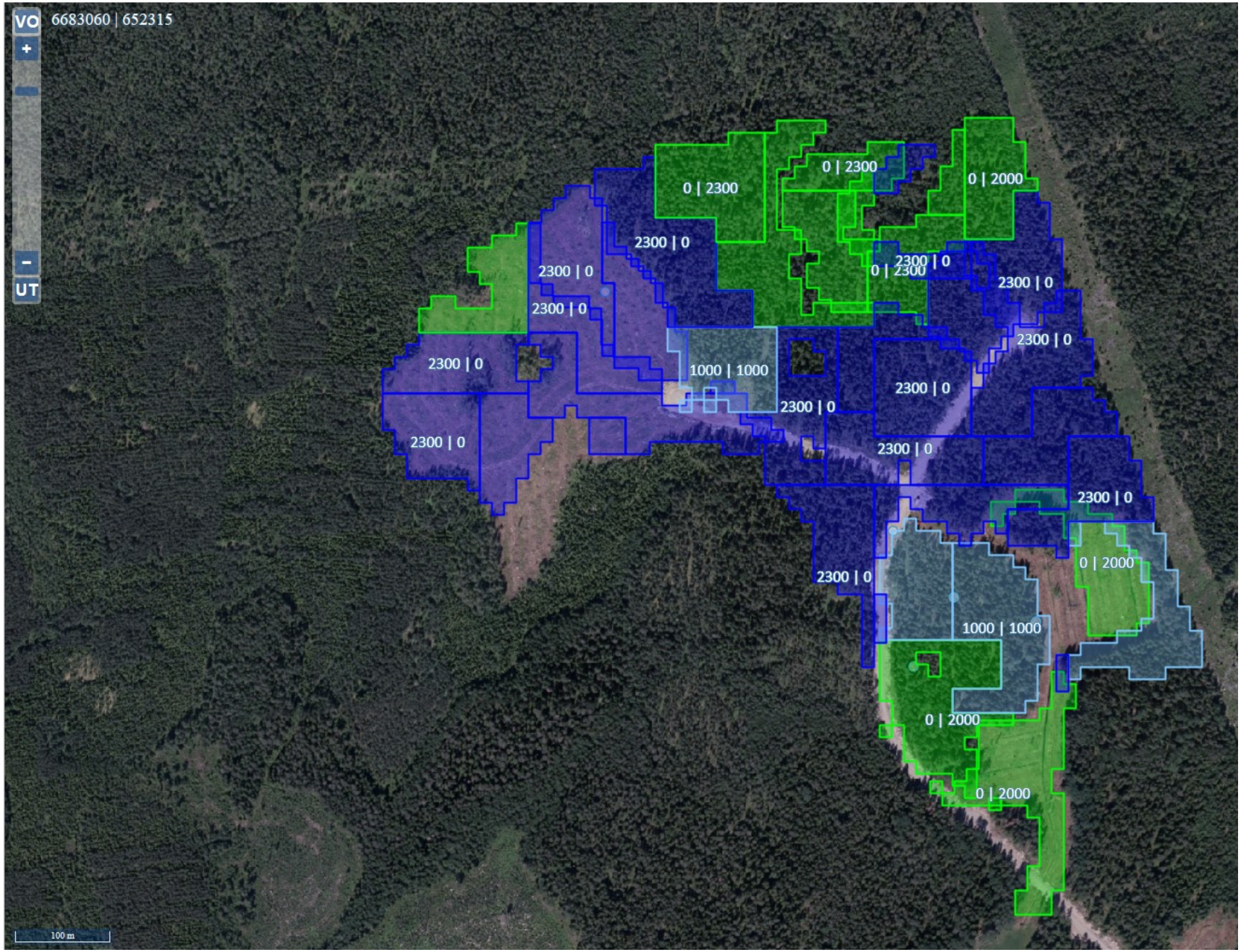
Totalt behövs 39977 tallplantor och 21379 granplantor, d.v.s. 2222 plantor/ha för 27.6 ha.

Tall	**15.9 ha**
Gran	**8.3 ha**
Gran-tall	**3.5 ha**
Gran-löv	
Löv	
Manuellt val	

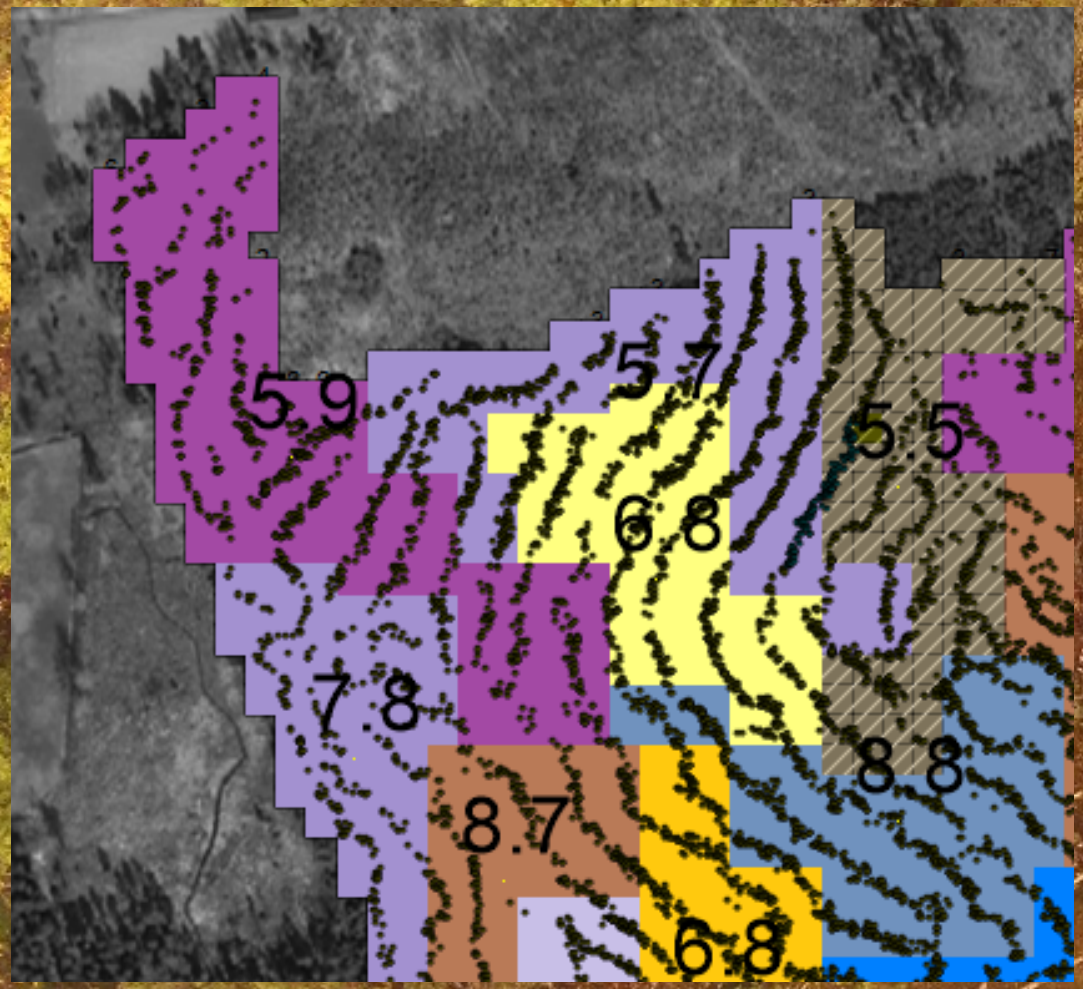
Exportera shapefil

----------09:21:20----------
14435 stammar fördelade på 32 beräkningsytor och 27.6 hektar har hämtats för VO 34435565.

----------09:20:10----------
11241 koordinatsatta objekt har hittats i databasen.

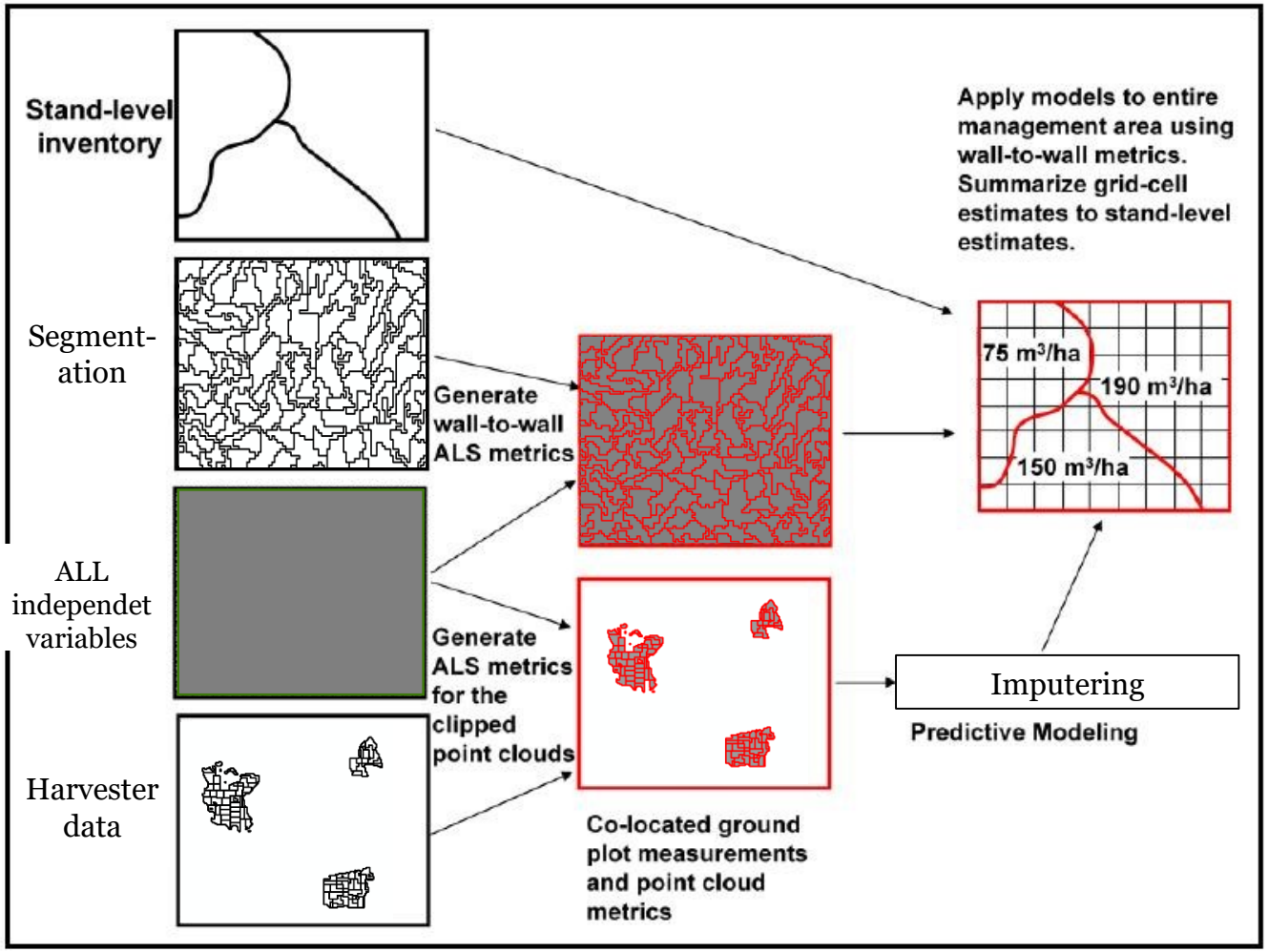


Forest estimates using harvester data as reference to remote sensing



Overview of method

- Area method
  - Imputering (kMSN)
- Machine learning
  - Deep Learning algoritm



White et al. 2013. A best practices guide for generating forest inventory attributes from airborne laser scanning data using an area-based approach. For. Chron. 2013, 89, 722–723

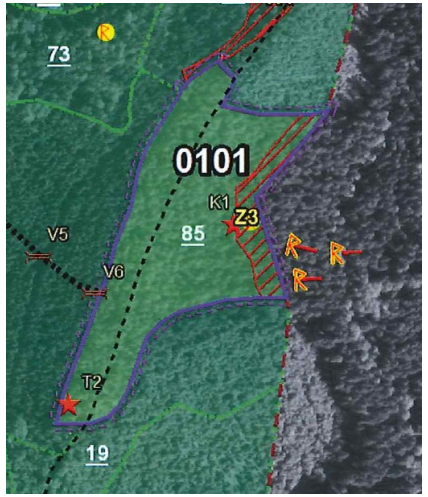
Results

Estimation using NFI plots				
	enhet	RMSE	RMSE%	Bias%
Volym	m^3sk/ha	57.3	21.8	4.6
Hgv	m	1.5	7.7	-0.4
Dgv	cm	3.1	12	-5.3
Gy	m^2/ha	5.8	21.1	-6.1

Estimations using harvester data				
	enhet	RMSE	RMSE%	Bias%
Volym	m^3sk/ha	35.5	19.2	-0.3
Hgv	m	1.2	6.6	-0.1
Dgv	cm	2.5	11.2	-0.1
Gy	m^2/ha	3.1	14.6	-0.1

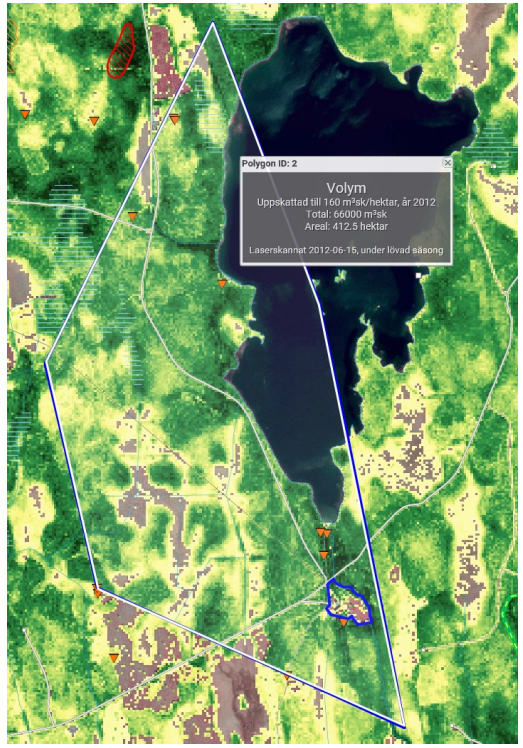
Up-date of forest estimates – new project

Old estimate



Forest stand data
Site index, age

New harvester data



Updated stand estimates