



How structural diversity modulates the growth performance of Silver fir dominated stands in Europe.

Field-Map technology as a tool that enhances data collecting to answer the formulated question

By: Bohdan Kolisnyk

Supervisors:

Dr. Kamil Bielak

Outline

Self
introduction

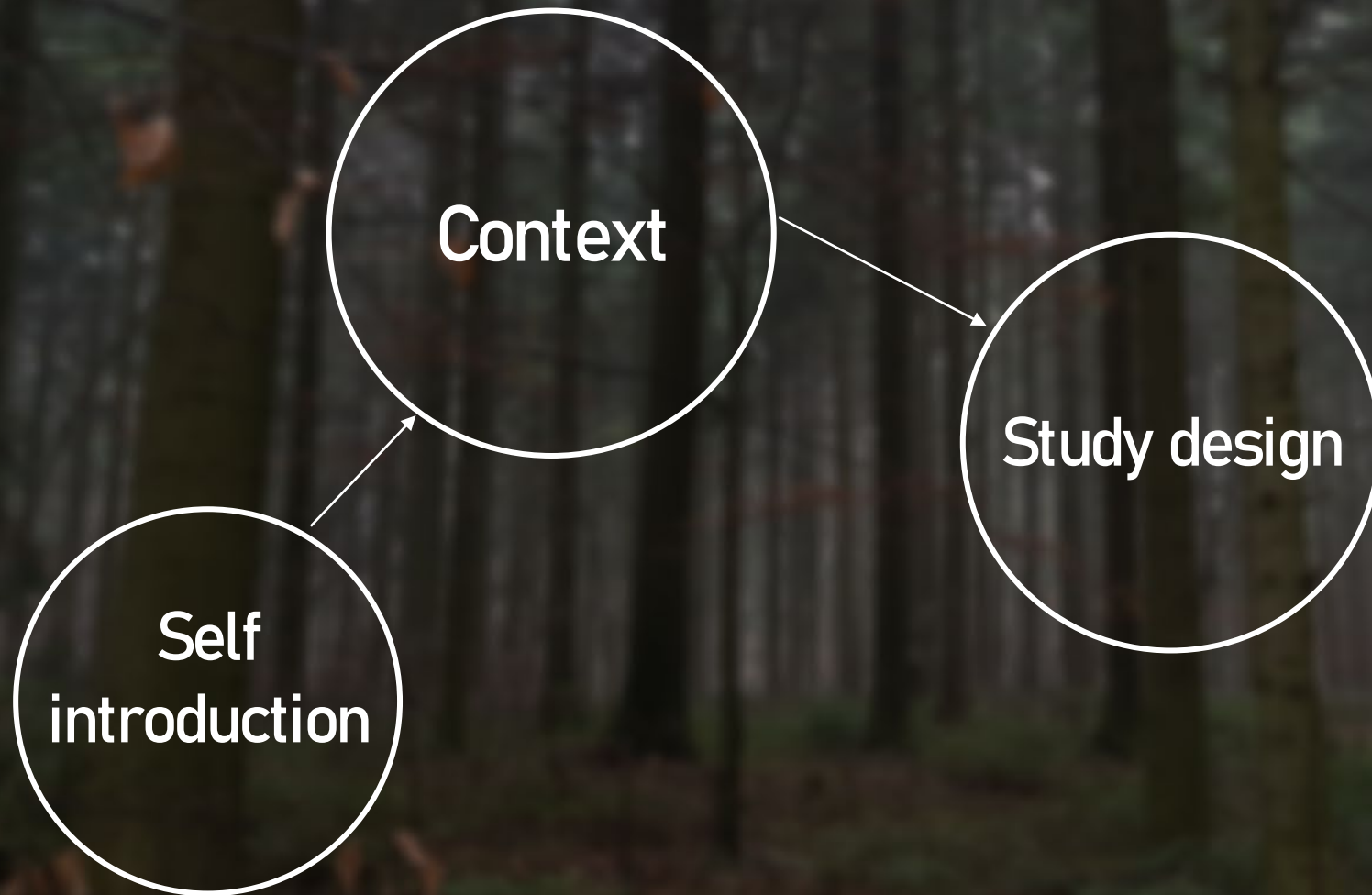
Outline

```
graph TD; A((Self introduction)) --> B((Context));
```

Context

Self
introduction

Outline



Outline



Outline





Skill-For.Action – S4A



Marie Skłodowska-Curie
European Training Network (ETN)

- Bohdan Kolisnyk
 - Ukrainian





Skill-For.Action – S4A



Marie Skłodowska-Curie
European Training Network (ETN)

- Bohdan Kolisnyk
 - Ukrainian

Accademic background:

- B.Sc. Ukrainian National Forestry University – Forestry.
- M.Sc. Ukrainian National Forestry University – Forestry.
- M.Sc. Eberswalde University for Sustainable Development – Forestry System Transformation.





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Recruited at: Warsaw University of Life Science, Institute of Forest Science, Department of Silviculture.

Enrolled at PhD School at: Doctoral School at Warsaw University of Life Science.





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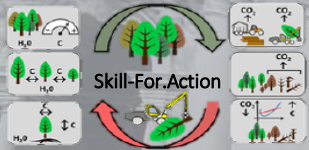
Title of the PhD project:

Growth resistance and resilience of *Abies alba* Mill. to drought stress in even- versus uneven-aged forests.

Supervisors:

Dr inż. Kamil Bielak.

Prof. dr hab. Stanisław Drozdowski.



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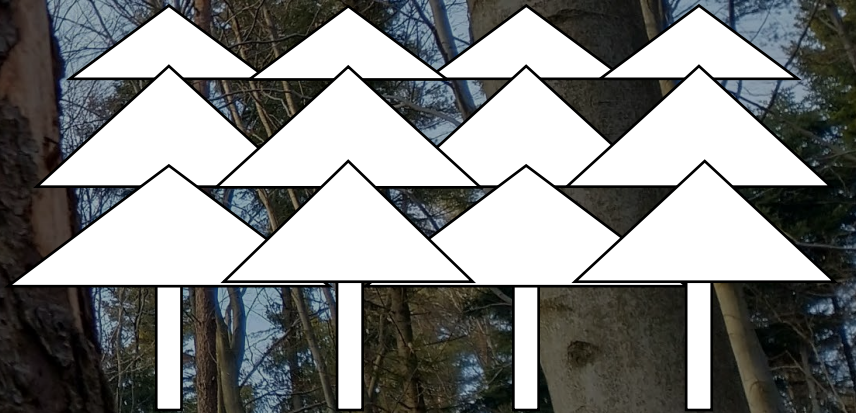
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Outline



Climate change

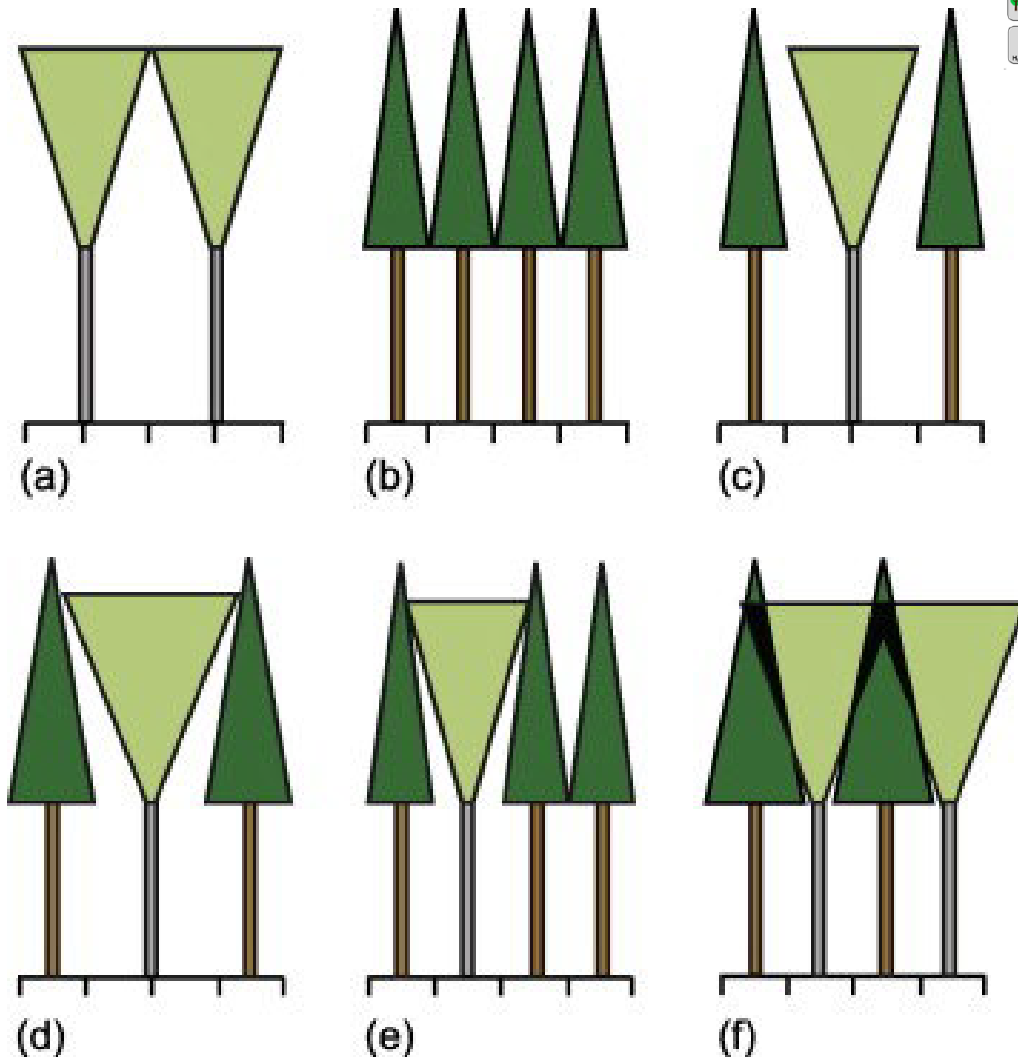




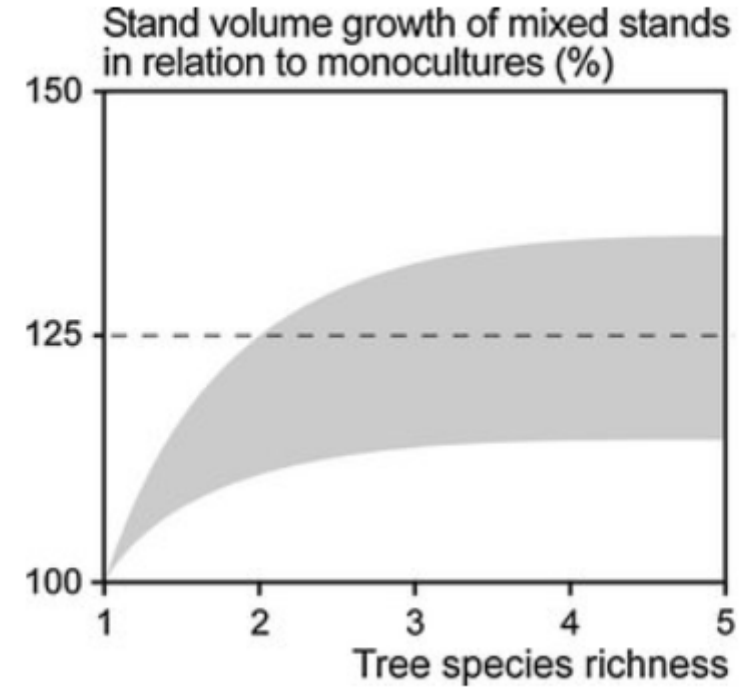
Climate change

Mixing





Canopy space filling and tree crown morphology in mixed-species stands compared with monocultures (Pretzsch, 2014)



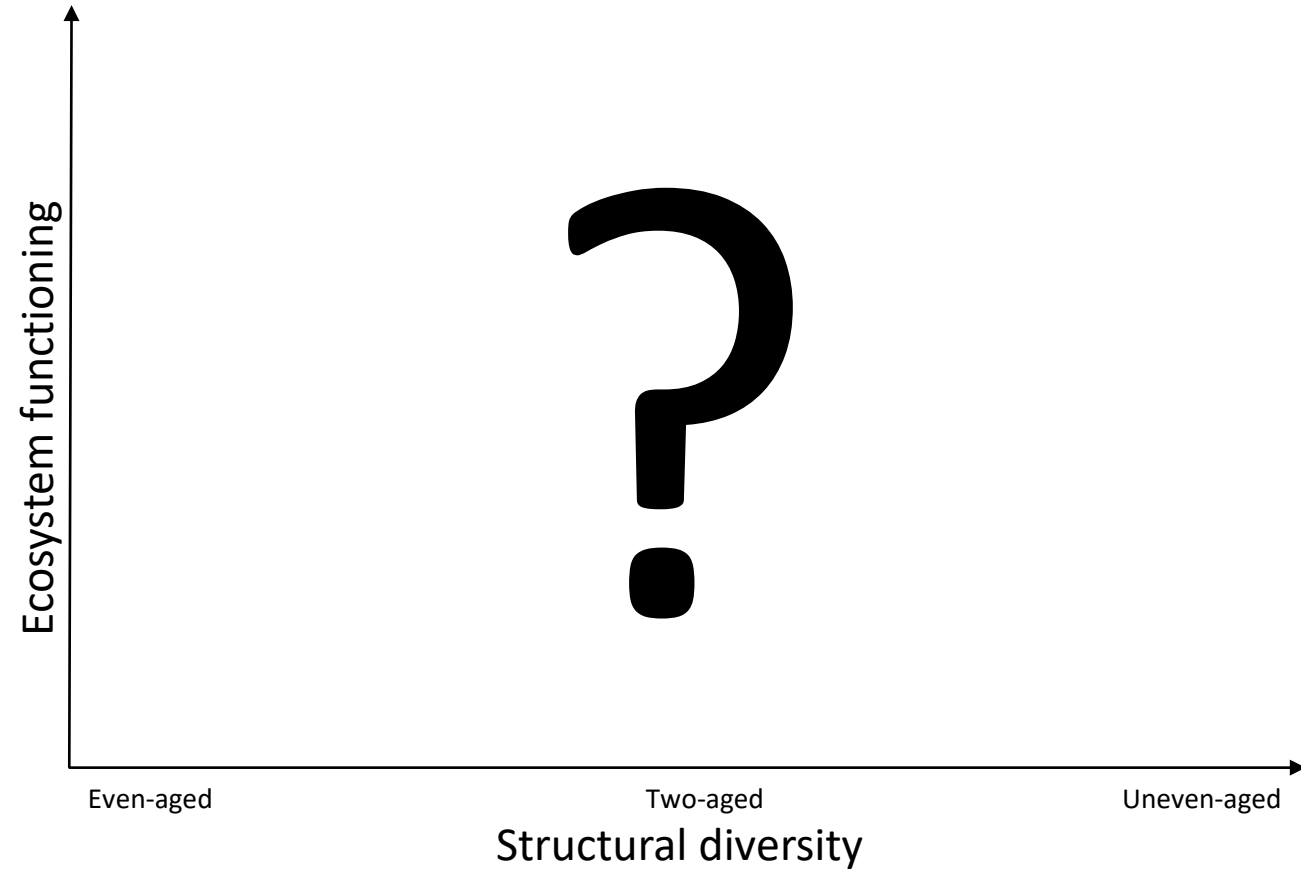
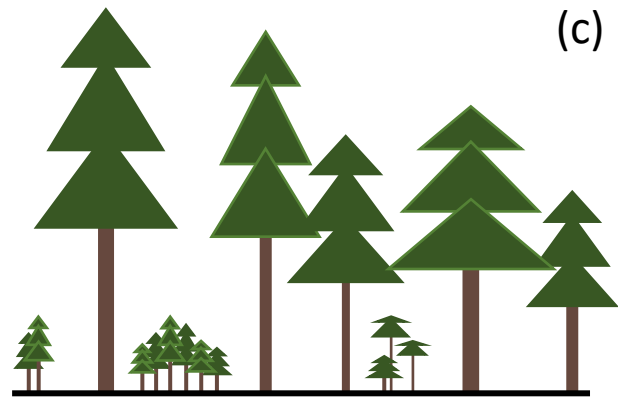
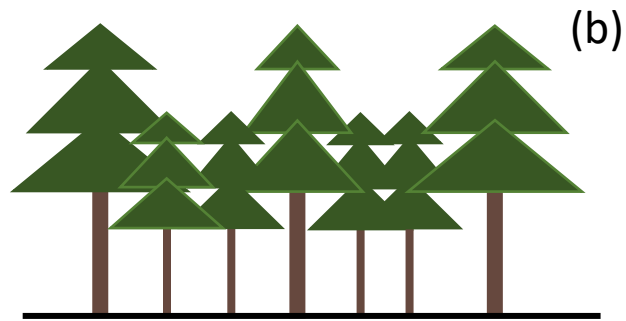
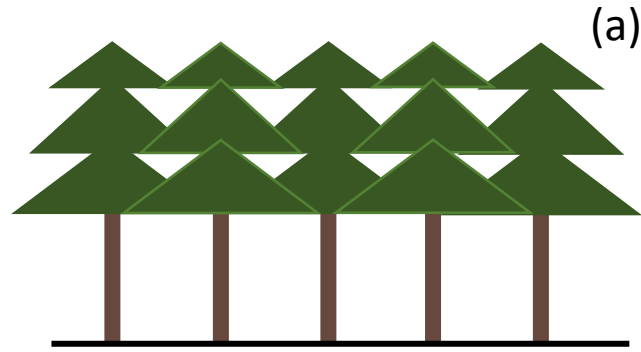
Degressive increase in the stand productivity with increasing tree species richness in temperate forests (Dieler et al, 2017)



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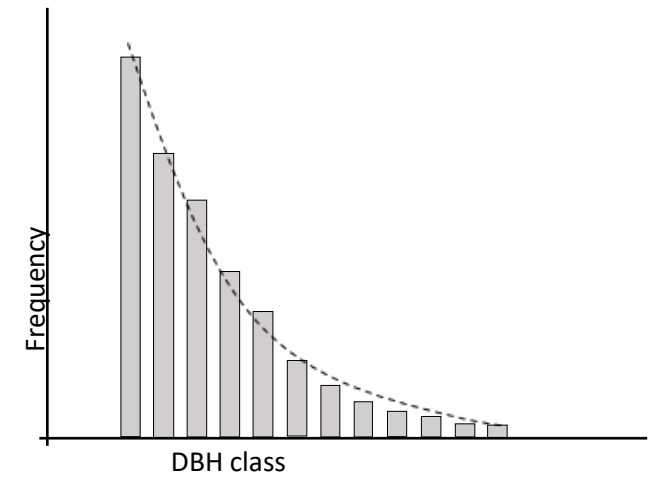
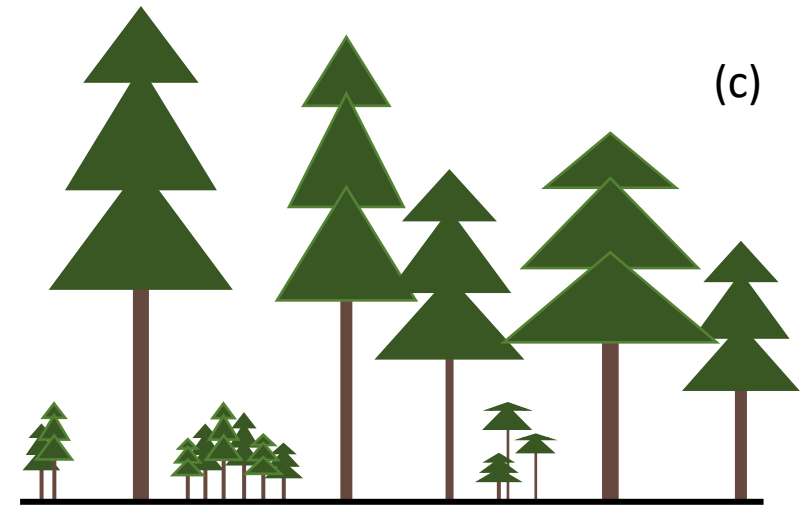
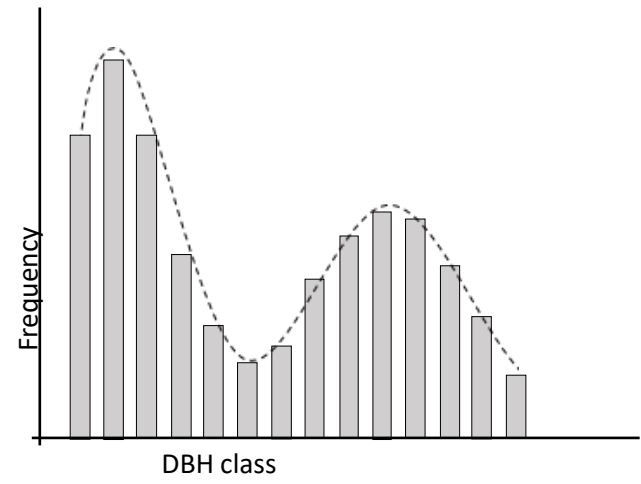
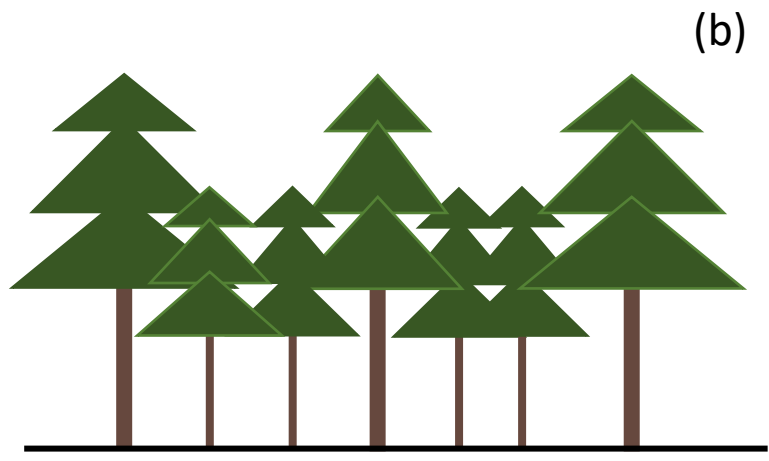
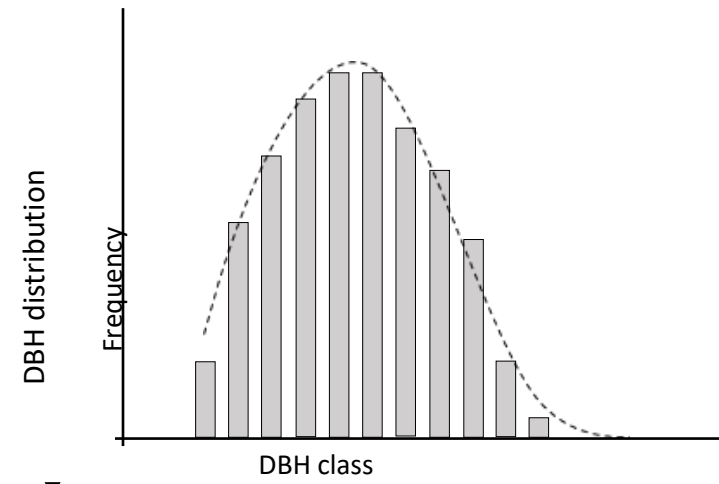
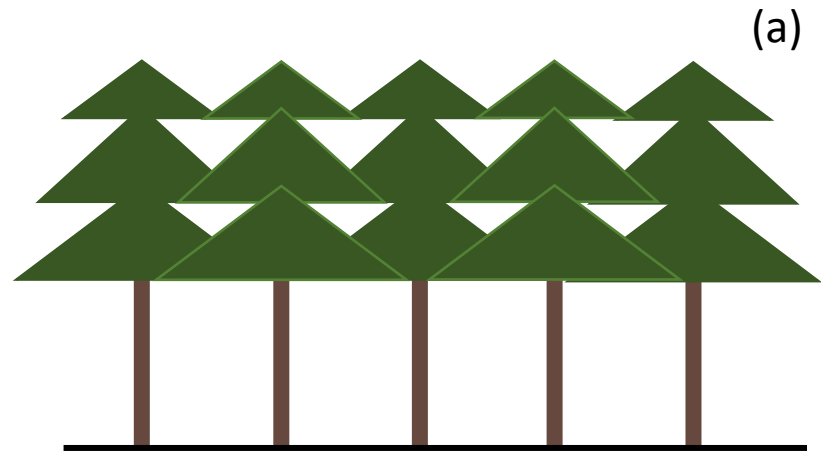
Structural diversity



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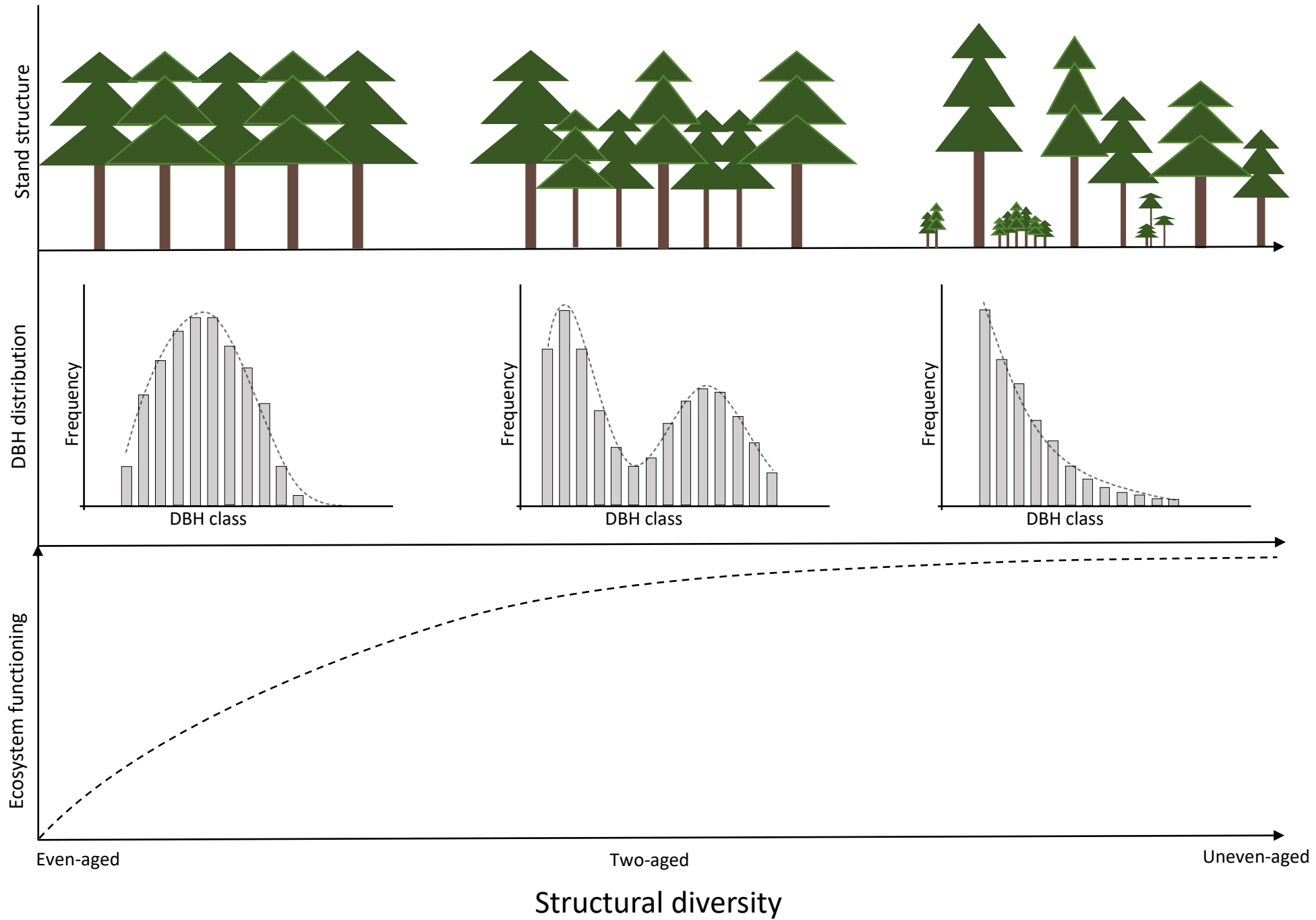




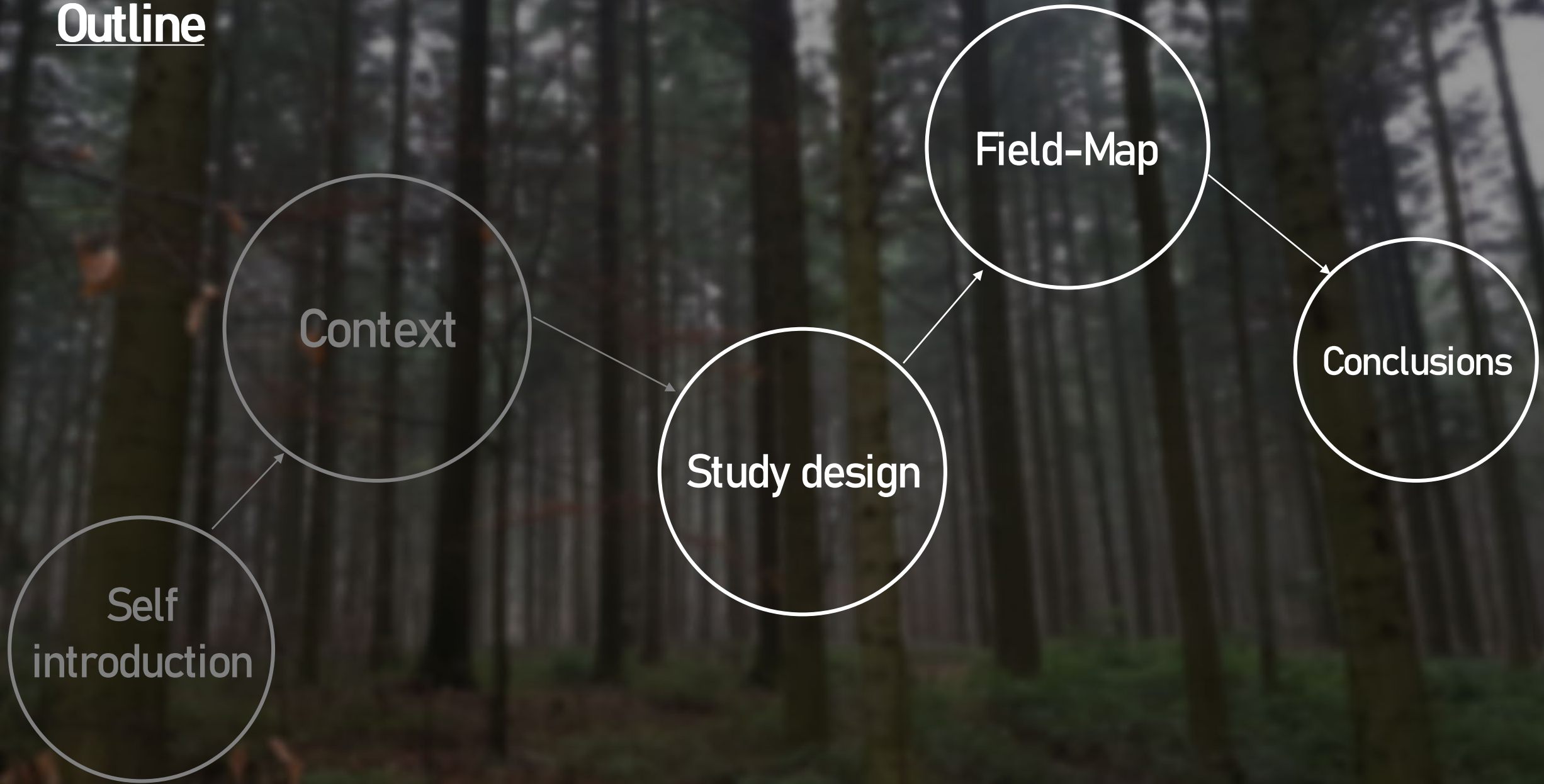
Research objective:

To examine the productivity, temporal growth stability, resistance, resilience, and recovery of Silver fir to climate extremes along the management and resulting structural diversity gradients.





Outline





Original study design:

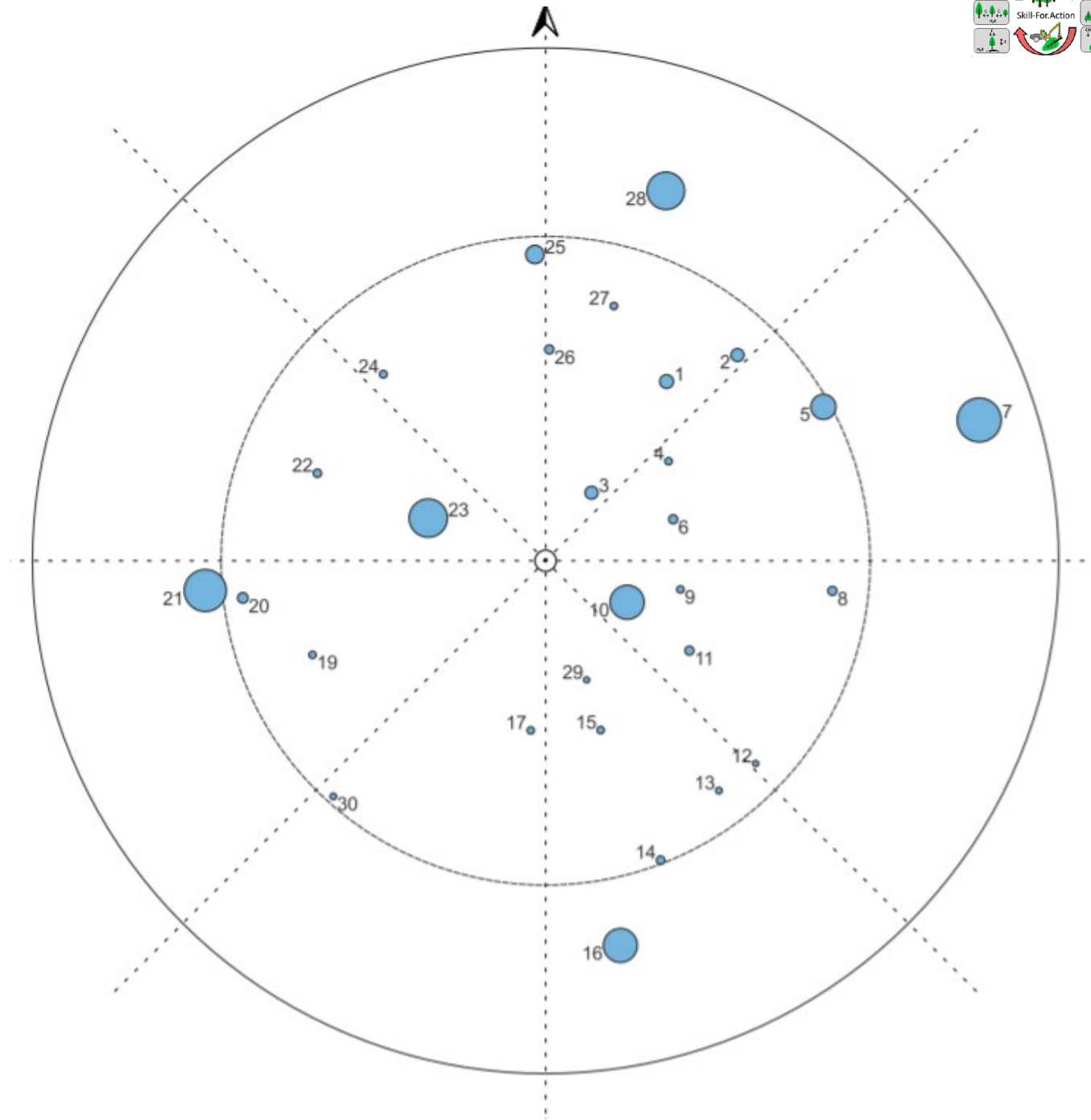
- 4 sites
- 4 countries
 - Poland
 - Ukraine
 - Germany
 - Italy





Plan B:

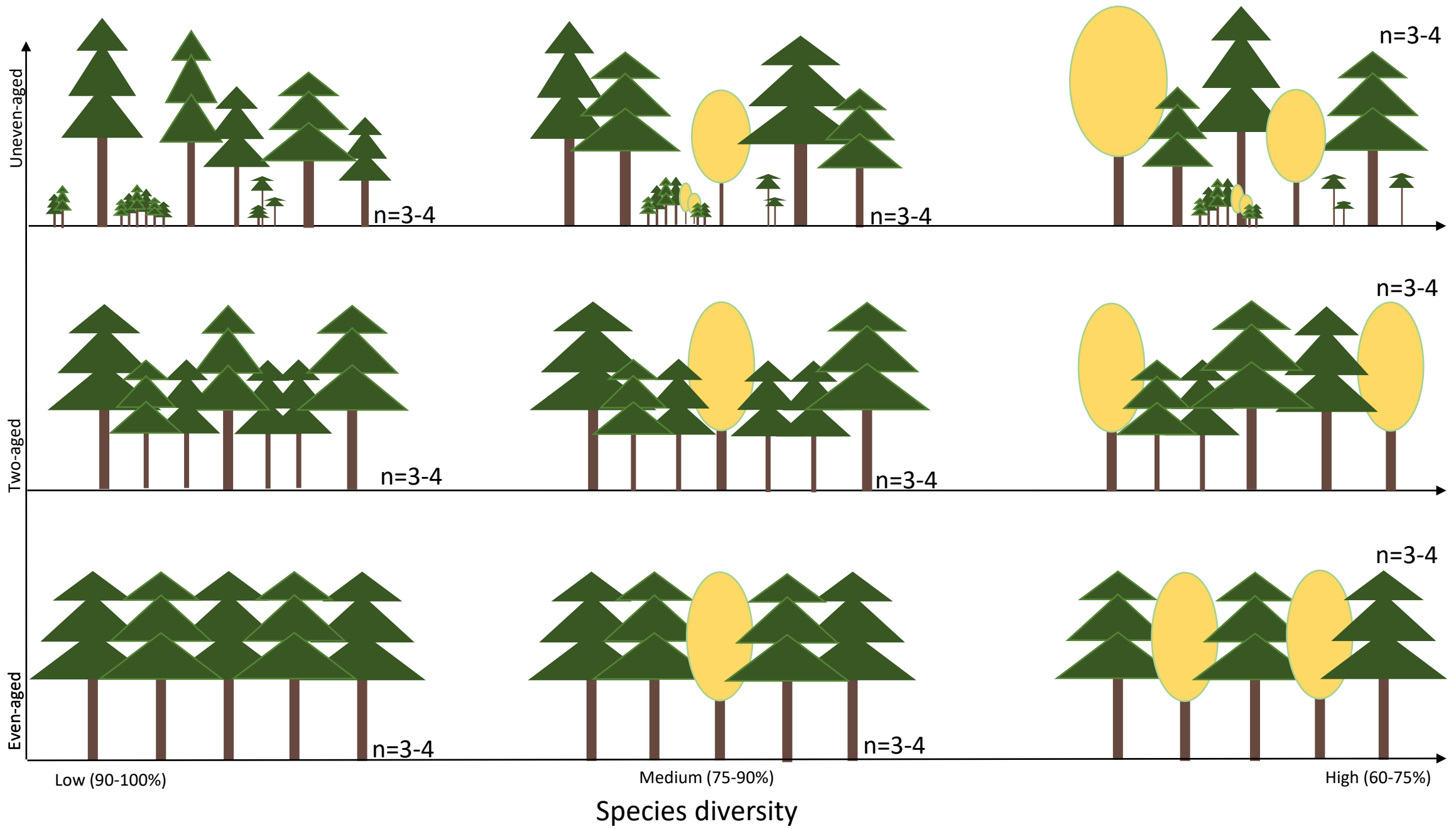
- 4 sites
- 2-3 countries
 - Poland
 - Ukraine
 - Germany
 - Italy



Study design:

- 30-36 circular plots per site:
 - site characteristics;
 - regeneration;
 - dendrometric characteristics;
 - tree position;
 - increment cores.

Structural diversity



Uneven-aged

Two-aged

Even-aged

Low (90-100%)

Medium (75-90%)

High (60-75%)

Species diversity

n=3-4

n=3-4

n=3-4

n=3-4

n=3-4

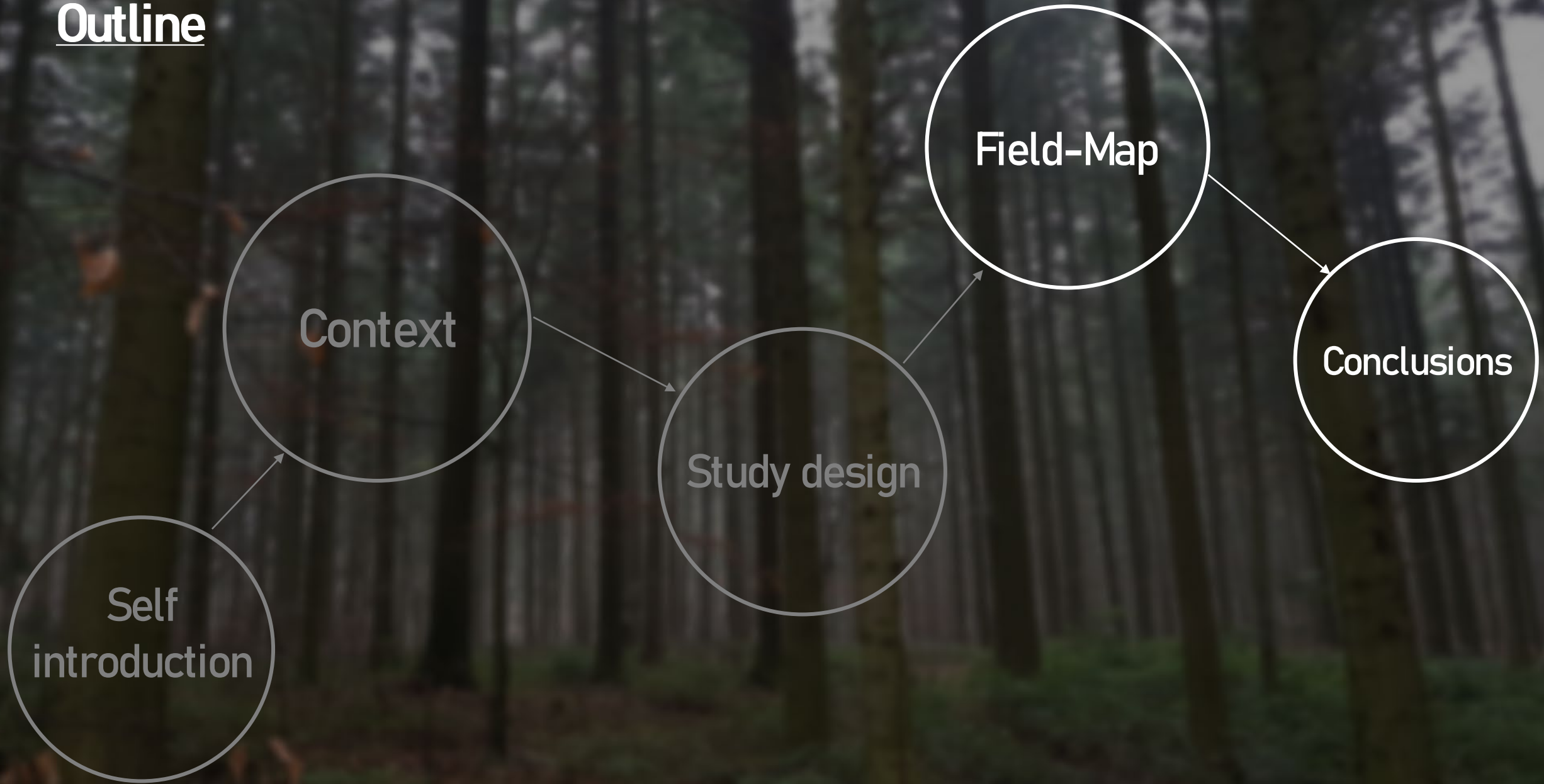
n=3-4

n=3-4

n=3-4

n=3-4

Outline







Number of measurements:

4 sites x 30-36 circular plots
per site = 120 - 144 plots

The screenshot shows a software window titled "Open Plot" with a green header bar that reads "Field-Map plots (n = 137)". Below the header is a table with two columns: "Plot ID" and "Plot name". The table contains 13 rows of data, with the first row (ID 1207) highlighted in blue. At the bottom of the window, there is a search bar labeled "Find:", a search icon, and radio buttons for "Name" and "ID" (the "ID" option is selected). Below the search bar are two buttons: "OK" with a green checkmark and "Cancel" with a red X.

Plot ID	Plot name
1207	1207
1208	1208
1209	1209
1210	1210
1211	1211
1212	1212
1213	1213
1214	1214
1215	1215
1216	1216
1217	1217

Area,m²: 500.000

Perimeter,m: 79.272

Magn.declin,: 1.4

Name: 817

Slope: <5

Aspect: 0

SiteType: Lwyzw

VegetationType: Ecio³a

Compartment: 8

Taem: bk

Date_and_time: 3/17/2022 10:33:25

Plot_type:

Structure_type:

Notes:

Notes2:



New plot

Open plot

Delete plot

Import data

Check data

Verify inheritance

Database tool

Synchronization

Show navigation

Extensions

Script editor

Settings

Activate look

Adjust device

Help

About

Close Field-M

ID	Spe
1	Jd
2	Sw
3	Bk
4	Gb

Species: Nalot ($w \geq 2, h \leq 0,5$) $r=1,26$ Total seedlings: Quality seedlings: Small saplings ($h > 0,5, d \leq 2$) $r=2,52$ Total small saplings: Quality small saplings: Podrost_W ($d > 2, d \leq 7$) $r=3,99$ Total tall saplings: Quality tall saplings: Orgin: Notes: Light conditions factor: 



Number of measurements:

50 trees per plot x 120 plots =
min 6000 measurements

ID	Species	d1	d2	Status	d3	Status	Dead
23	Jd				105	Living	
24	Jd				73	Living	
25	Jd				97	Living	
26	Jd				95	Living	
27	Os				73	Living	
28	Gb				81	Living	
29	Os				78	Living	
30	Jd				73	Ingrov	
31	Brz				85	Ingrov	
32	Gb				68	Ingrov	
33	Jd				296	Living	
34	Jd				70	Ingrov	
35	Jd				90	Ingrov	
36	Jd				110	Living	
37	Jd				108	Living	
38	Jd				138	Living	



Tree characteristics

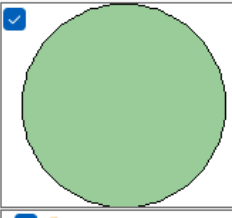
For all trees:

- Tree number: 1, 2, ..., n ;
- Tree species (*Fagus sylvatica*, *Abies alba*, etc.);
- Tree diameter (DBH, in cm)
- Tree position in the plot;
- Status.

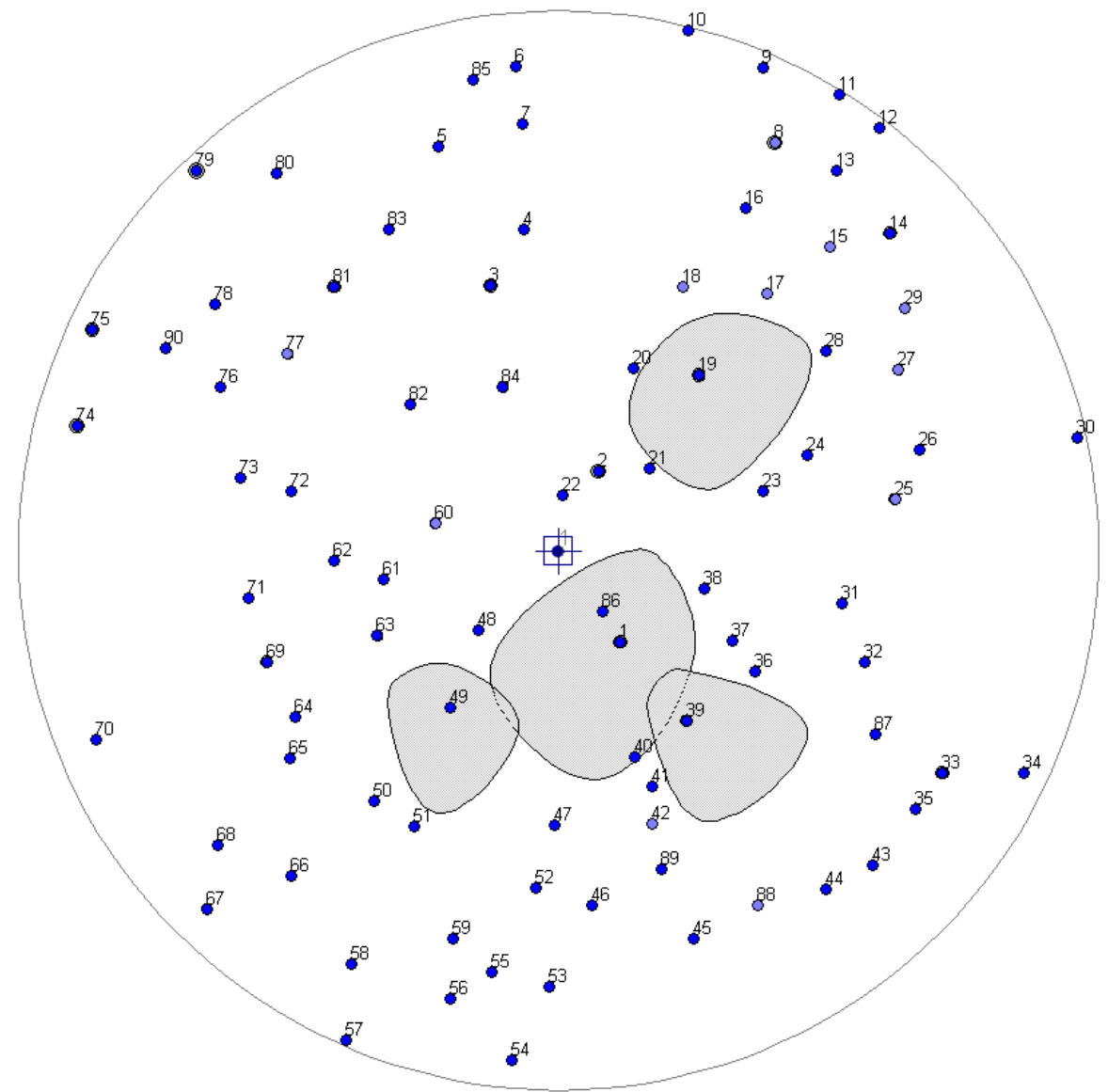
For the selected trees:

- Total height (H , in m);
- Height to crown base (in m), i.e., to the lowest living branch that creates the continuous of the crown;
- Crown projection (4 directions);
- Record of any severe damages (wind breakage, decay, beetle damage, etc.).





- Plots
- Reference points
- GPS ref. points
- DEM
- Tree
- Crown projections
- Circle





Tree characteristics

For all trees:

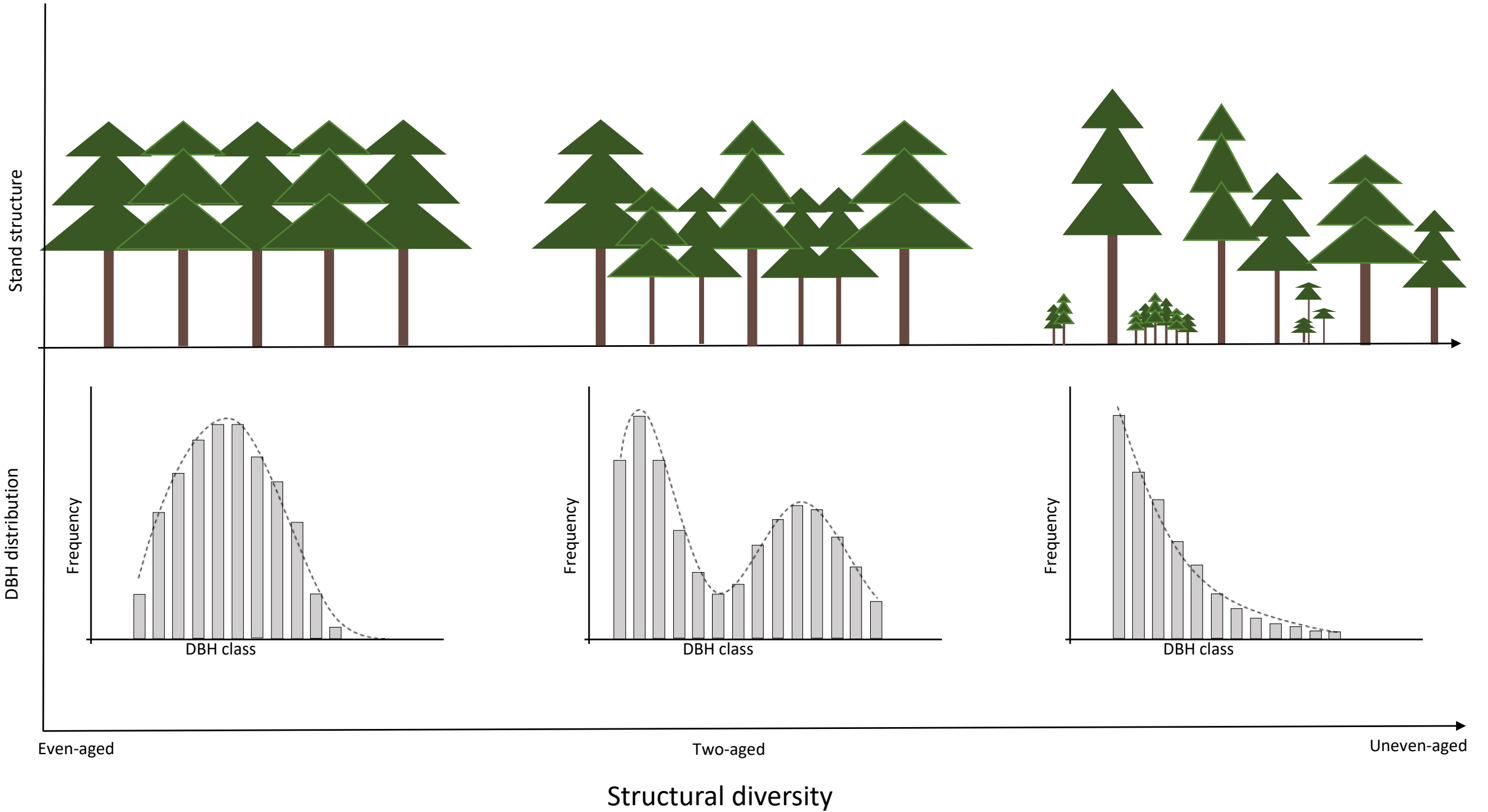
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- Record of any severe damages (wind breakage, decay, beetle damage, etc.).



Database structure





Structure type:

Area,m ² :	<input type="text" value="500.000"/>
Perimeter,m:	<input type="text" value="79.272"/>
Magn.declin,°:	<input type="text" value="1.4"/>
Name:	<input type="text" value="817"/>
Slope:	<input type="text" value="<5"/>
Aspect:	<input type="text" value="0"/>
SiteType:	<input type="text" value="Lwyzw"/>
VegetationType:	<input type="text" value="Naga"/>
Compartment:	<input type="text" value="8"/>
Taem:	<input type="text" value="bk"/>
Date_and_time:	<input type="text" value="3/17/2022 10:33:25"/>
Plot_type:	<input type="text" value="PhD"/>
Structure_type:	<input type="text" value=""/>
Notes:	<input type="text" value="multi-aged"/>
Notes2:	<input type="text" value="two-aged"/>
	<input type="text" value="even-aged"/>

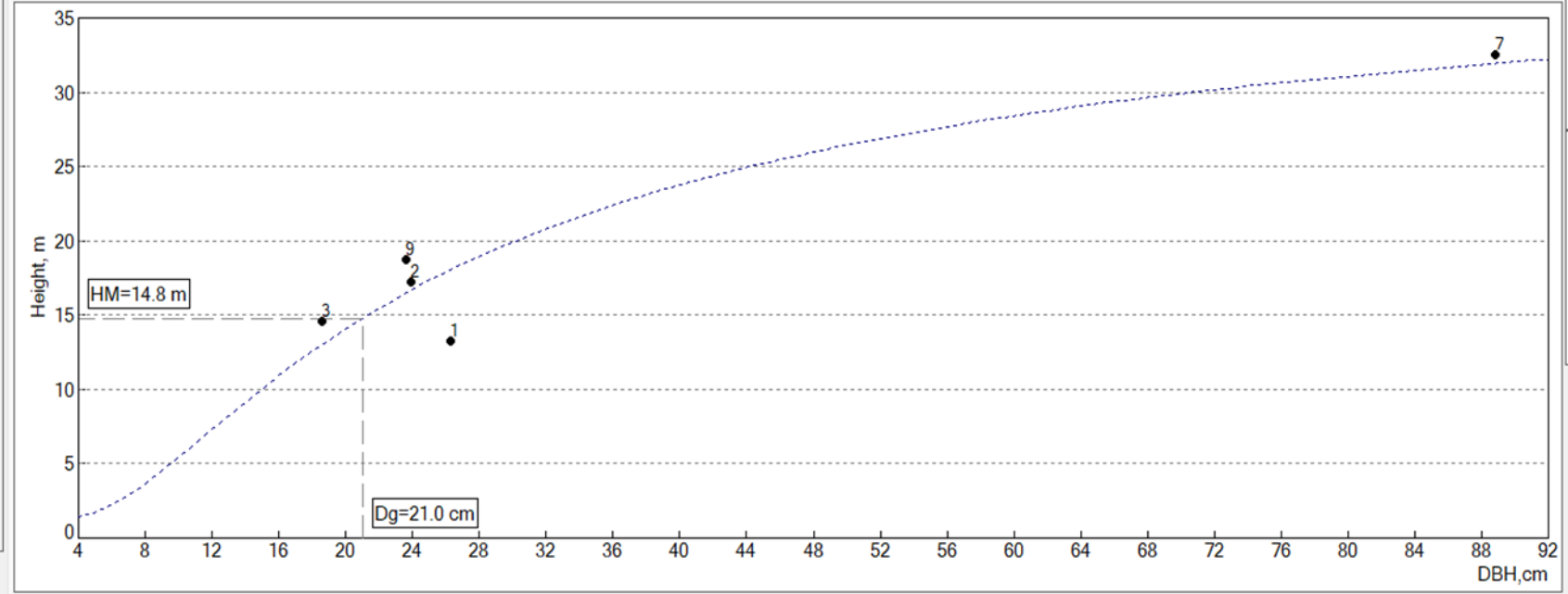
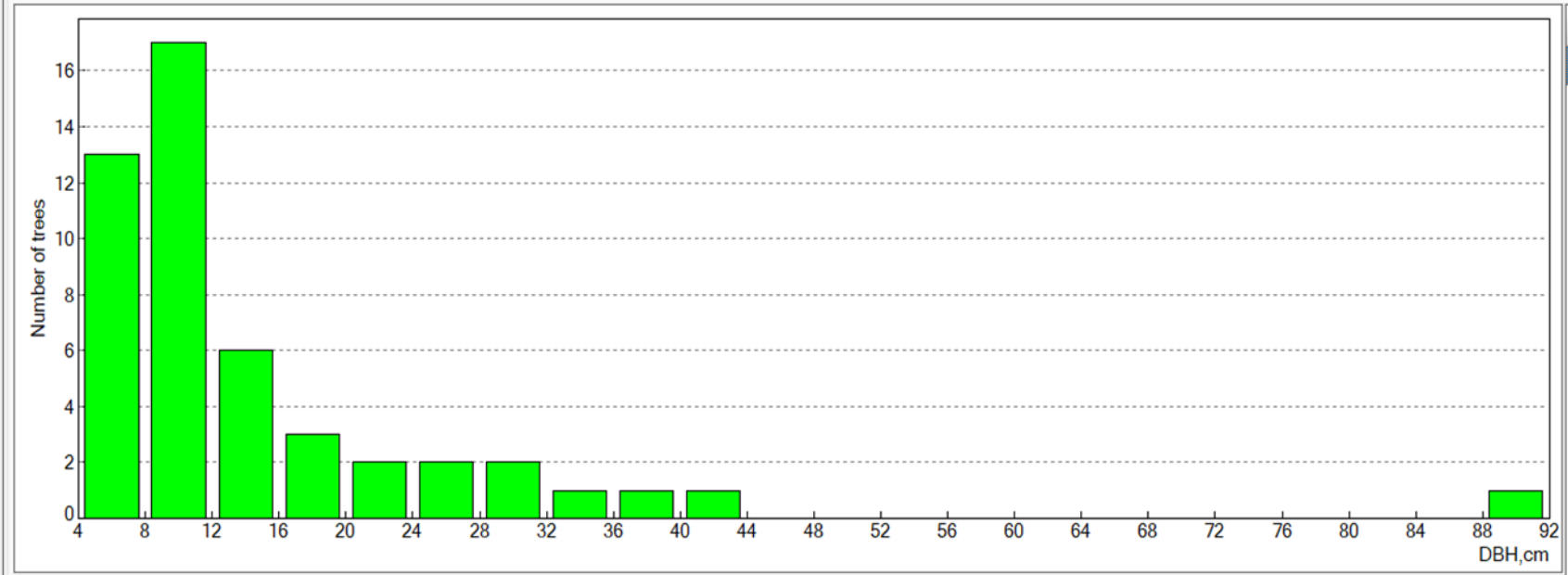






ID	Species	d1	d2	Status	d3	Status	Dead
23	Jd				105	Living	
24	Jd				73	Living	
25	Jd				97	Living	
26	Jd				95	Living	
27	Os				73	Living	
28	Gb				81	Living	
29	Os				78	Living	
30	Jd				73	Ingro	
31	Brz				85	Ingro	
32	Gb				68	Ingro	
33	Jd				296	Living	
34	Jd				70	Ingro	
35	Jd				90	Ingro	
36	Jd				110	Living	
37	Jd				108	Living	
38	Jd				138	Living	
39	Gb				189	Living	
40	Jd				76	Ingro	
41	Jd				84	Living	
42	Jd				80	Living	
43	Jd				131	Living	
44	Jd				78	Living	
45	Jd				75	Living	
46	Jd				184	Living	
47	Jd				79	Ingro	
48	Jd				119	Living	
49	Jd				78	Living	
50	Jd				73	Stum	6-10

Basic data DBH-H Crown projection Crown profile



Species	N	Code
All species	50	
Gb	4	2
Bk	1	3
Brz	1	4
Jd	39	6
Sw	2	12
Os	3	14

Stand statistics	
Dg, cm	21.0
HM, m	14.8
G, m ²	1.70
G, m ² /ha	33.9
N, 1	49
N, 1/ha	980


Copy to clipboard

DBH class, cm: 4

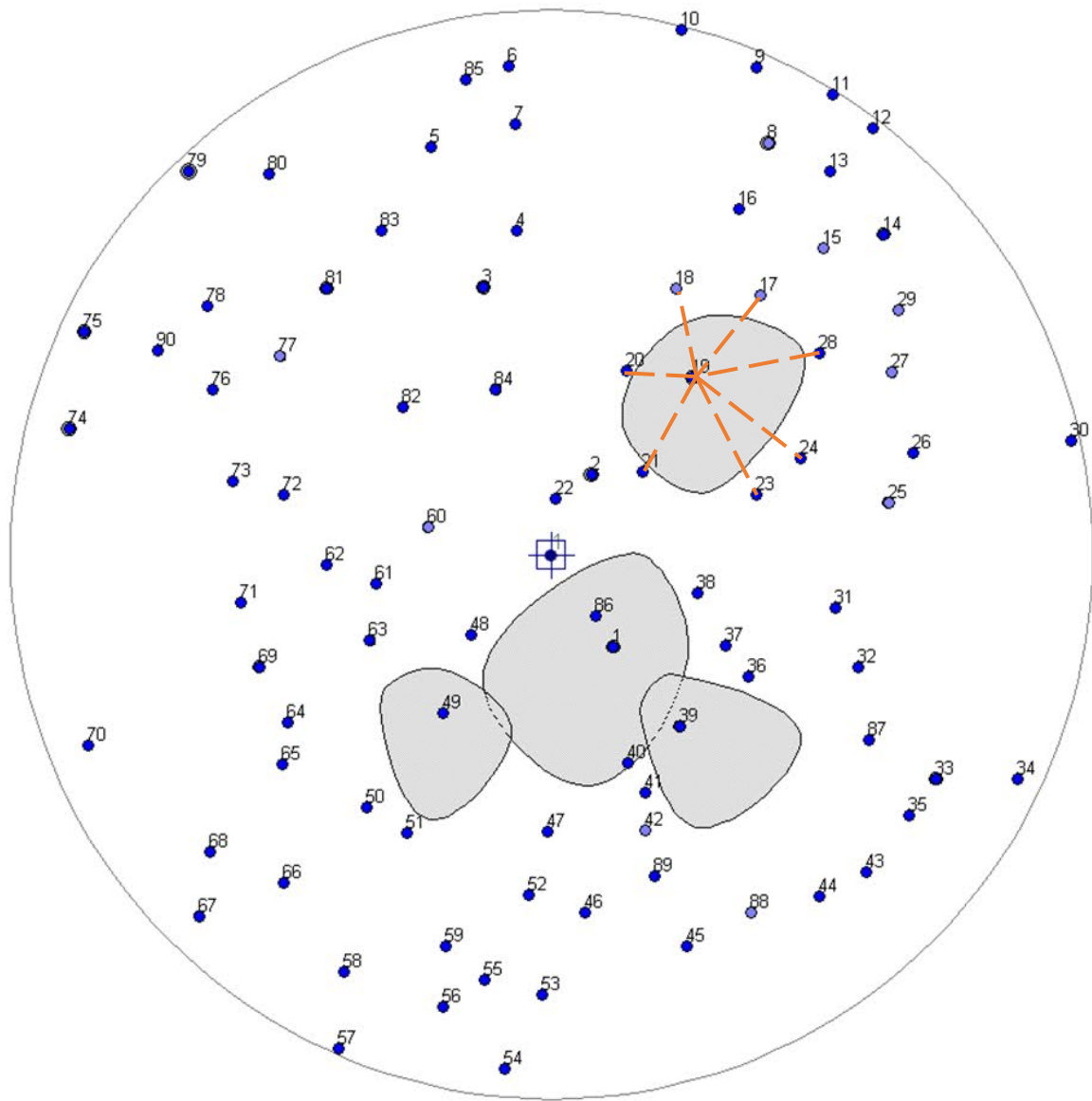
Show tree numbers

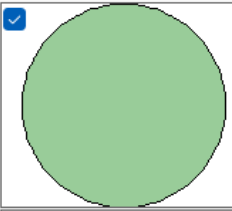
Show candidates



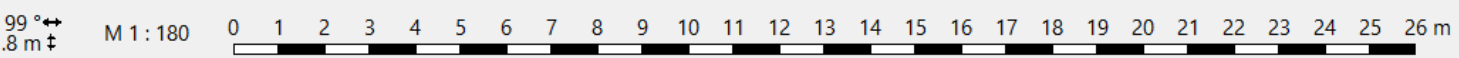
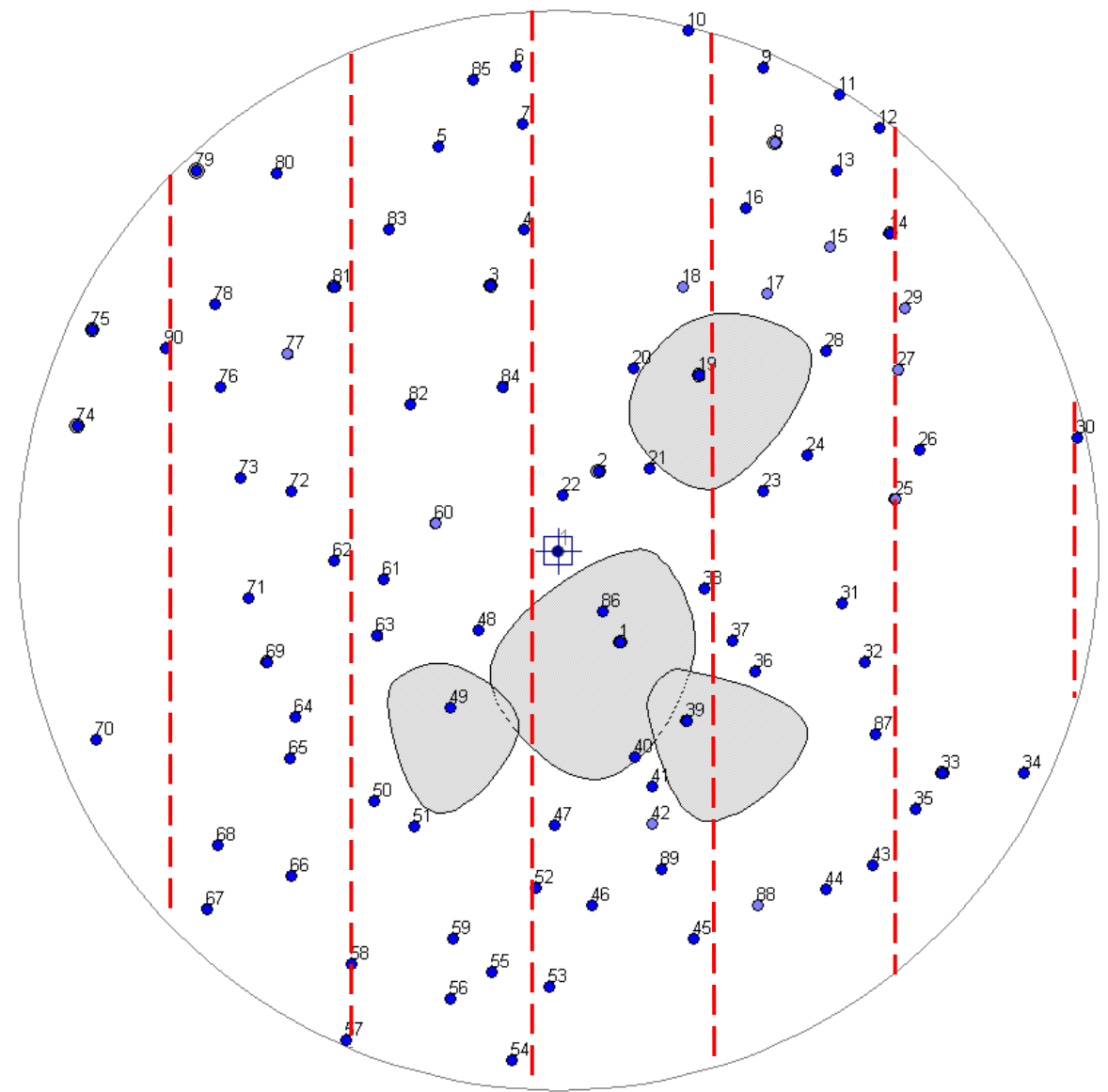


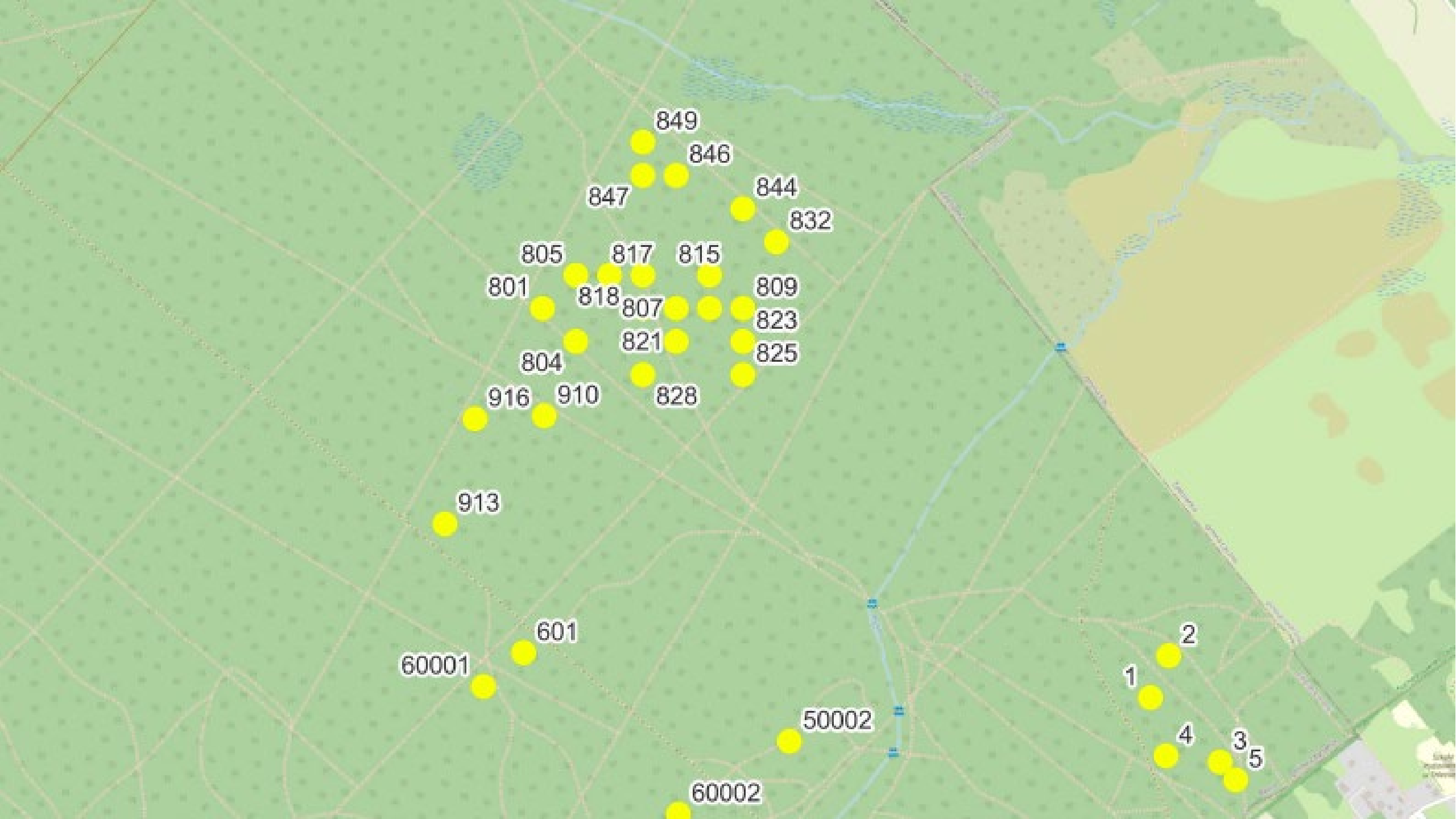
**Why do we need
spatial information?**

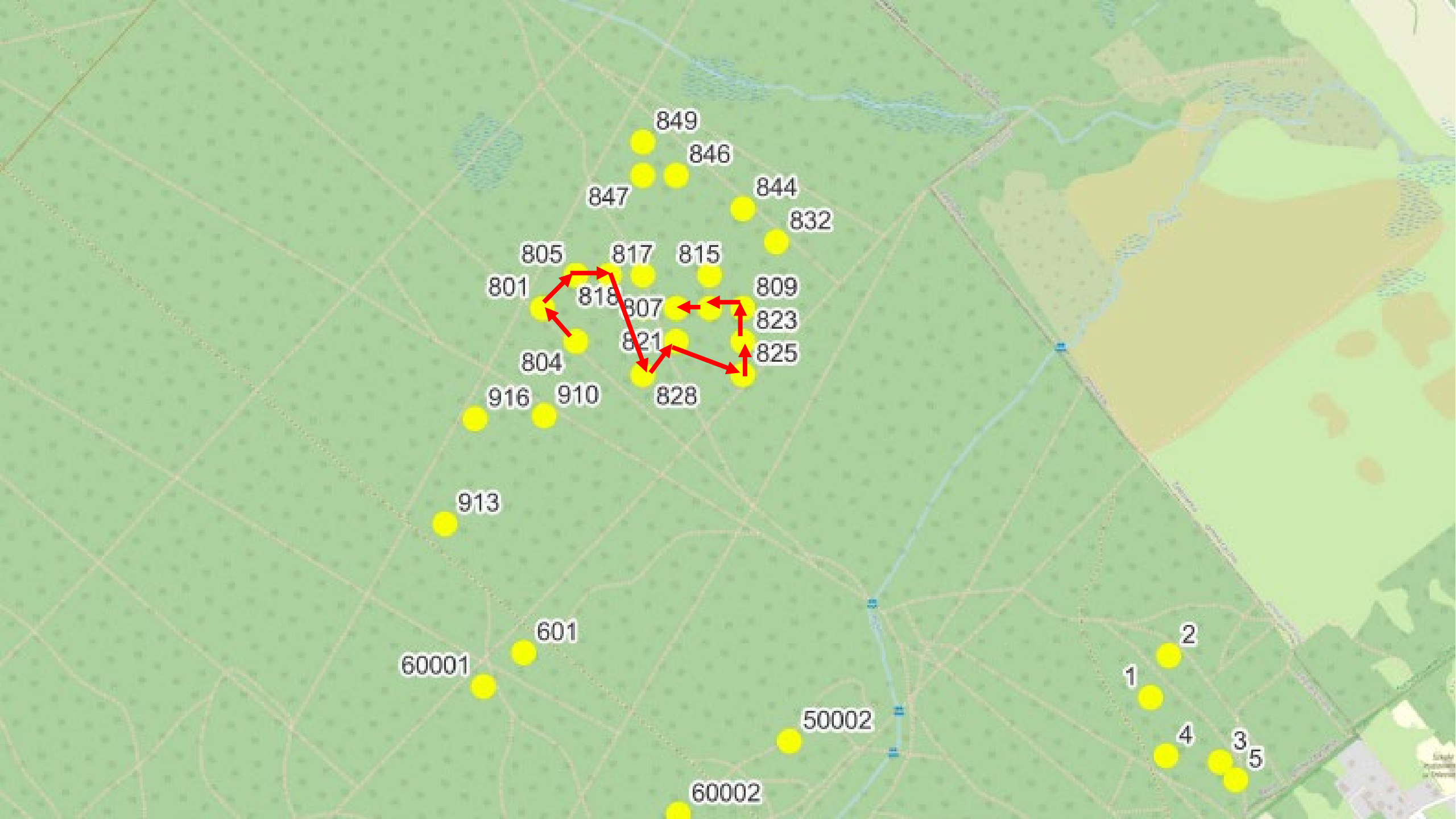




- Plots
- Reference points
- GPS ref. points
- DEM
- Tree
- Crown projections
- Circle



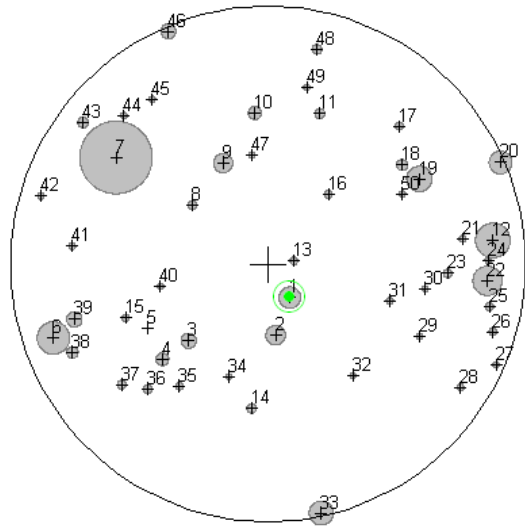






Best features

Overview map



Precision check

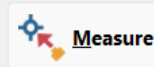
Std. dev., m:

N/A

Tree list

ID	Species	DBH, m...	Easting, m	Northing, ...	Altitude, ...
7	Jd	888	-7.446	5.214	
12	Os	424	11.009	1.157	
6	Sw	398	-10.514	-3.62	
22	Jd	358	10.748	-0.826	-0.3
19	Jd	311	7.411	4.166	-0.6
33	Jd	296	2.608	-12.192	0.5
20	Jd	279	11.386	4.969	-0.8
1	Jd	263	1.068	-1.644	
2	Jd	239	0.367	-3.491	
9	Bk	236	-2.2	4.942	
39	Gb	189	-9.488	-2.705	0.4
3	Jd	186	-3.892	-3.758	
46	Jd	184	-4.884	11.392	-0.5
10	Jd	160	-0.647	7.392	
4	Jd	156	-5.18	-4.664	
38	Jd	138	-9.582	-4.333	0.3
18	Jd	135	6.563	4.846	-0.6
43	Jd	131	-9.056	6.928	-0.5
11	Gb	123	2.536	7.366	
48	Jd	119	2.39	10.507	-0.9
14	Jd	117	-0.804	-7.065	0.2
36	Jd	110	-5.906	-6.128	0.1
37	Jd	108	-7.164	-5.901	0.5
8	Jd	107	-3.712	2.9	
23	Jd	105	8.795	-0.463	-0.4

Tree ID	Easting, m	Northing, m	Altitude, m



Current position

Easting, m: Northing, m:

Consider correction of magn. declin., °:




```

1 getwd()
2 ##setwd("C:/Users/SGGW_KHL/Documents")
3 dd <- read.csv("Trees_zagnansk2.csv")
4 names(dd)[c(1)]=c("Plot.ID")
5 dd[is.na(dd)] <- 0
6 library(REAT)
7 library(dplyr)
8 dd$BA3 <- pi*dd$d3^2/4000000
9 Plots <- data.frame(ID = c(1,2,3,4, 601, 801, 804, 805, 806, 807, 808, 809, 815, 817, 818, 821, 823, 825, 828, 832, 844, 846, 847, 849, 910, 913, 916, 1204, 1209, 1210),
10                      Gini = c(NA), CV = c(NA), LikeJ = c(NA), ShannonDBA = c(NA), ShannonDBH = c(NA), ShannonDBAEV = c(NA), ShannonDBHEV = c(NA), SL = c(NA),
11                      TBA=c(NA))
12 ID <- c(1,2,3,4, 601, 801, 804, 805, 806, 807, 808, 809, 815, 817, 818, 821, 823, 825, 828, 832, 844, 846, 847, 849, 910, 913, 916, 1204, 1209, 1210)
13 ##Ntrees
14 for (i in ID) {
15   Pow <- i
16   dd1 <- dd %>% filter(Plot.ID == Pow, Status3 == 1)
17   Plots[Plots$ID == Pow ,"Ntrees"] <- length(dd1$d3)
18 }
19
20 ##Total basal area
21 for (i in ID) {
22   Pow <- i
23   dd1 <- dd %>% filter(Plot.ID == Pow, Status3 == 1)
24   Plots[Plots$ID == Pow ,"TBA"] <- sum(dd1$BA3)
25 }
26 ##mean ba
27 for (i in ID) {
28   Pow <- i
29   dd1 <- dd %>% filter(Plot.ID == Pow, Status3 == 1)
30   Plots[Plots$ID == Pow ,"TBA"] <- mean(dd1$BA3)
31 }
32
33
34 ##Max diameter
35

```

77:64 (Top Level)

R Script

```

R 4.1.2 ~\
help.start() for an HTML browser interface to help.
Type 'q()' to quit R.

```

[workspace loaded from ~/.RData]

> |

Object	Size
Bigges...	1 obs. of 3 var...
DBH_C1...	17 obs. of 4 va...
DBH_C1...	12 obs. of 8 va...
dd	1737 obs. of 46...
dd1	24 obs. of 46 v...
df_fir...	1 obs. of 2 var...
Plots	35 obs. of 2 va...

DBH_1	49L
TD	num [1:35] 1 2 3

Outline







Advantages:

- User friendly;
- Highly accurate;
- Reliable.

Disadvantages:

- Still need humans to work.

A blurred background of a forest with tall, thin trees. The trees are dark and vertical, creating a sense of depth and perspective. The ground is covered in green grass and some fallen leaves.

Questions?



ETN Skill-For.Action



The Skill.For.Action is funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie -GA 936355

