Candidate 3

TREE GROWTH IN A PLANTATION

Aim

To investigate variation in tree trunk girth in a plantation.

Underlying environmental science

In a natural woodland different types of tree at different heights and age would be seen, with shrubs and ground plants growing around and below them. In a plantation, all the trees are planted at the same time and so will be the same age. In some plantations the trees are planted very close together to force them to grow up towards the light and will be sheltered by neighbouring trees from wind. These trees will be very tall and straight with narrow trunks. In a natural woodland trees would usually have thicker but more twisted trunks.

The planted trees will all have the same abiotic needs and being planted close together will result in competition between them, with few shrubs or ground plants able to survive around and below them. Biodiversity in a plantation will therefore usually be low. Foresters looking after the plantation will know how many trees to plant in the area to get maximum growth from each tree in the smallest area. This is known as the stocking density.

We were looking at a Scots pine plantation which is shown on a map dating to 1987. We know then that the plantation must be at least 32 years old.

Methodology

1. Each group picked a different location in the wood.
2. Each group marked out a 20m x 20m quadrat using rope.
3. The tree species were identified.
4. A 1.5m long bamboo cane was placed against the tree trunk and the girth was measured at the top of the cane. We repeated this for all 24 trees in the quadrat.
5. We identified the tree closest to the one being measured and noted down the distance between them. This was repeated for all 24 trees in my group's quadrat.

Data

Raw data

Tree number	Trunk girth (cm) at 1.5m height	Nearest neighbour distance (cm)
1	110	251
2	114	310
3	98	183
4	126	420
5	108	375
6	121	242
7	116	387
8	134	228
9	117	224
10	152	312
11	94	358
12	102	381
13	108	300
14	116	575
15	128	417
16	91	267
17	109	151
18	135	298
19	144	305
20	128	276
21	103	404
22	111	416
23	99	324
24	108	299
MEAN	116	321

Secondary data:

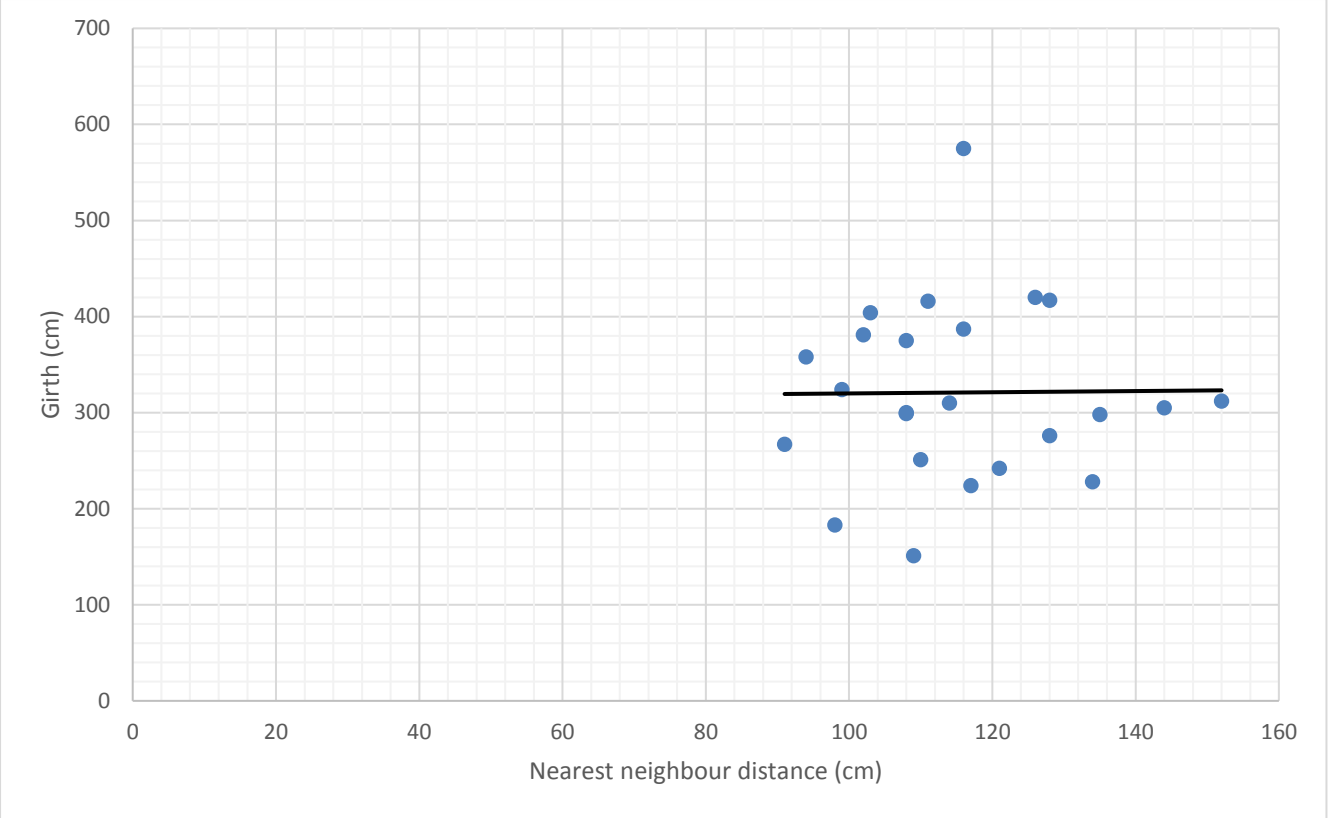
Mean increase in girth per year for different types of tree (1).

Species	Yearly increase in girth (cm)
Oak	1.9
Beech, ash	2.5
Sycamore	2.75
Pine, spruce	3.15

From this we can work out that the mean age of the trees in my quadrat is 116 ÷ 3.15 = 37 years

Graph

I plotted the girth of each tree against the distance to its nearest neighbour to see if there is a relationship between them.



Analysis

The trend line shows that there is not a relationship between tree girth and distance to the nearest tree.

We can use nearest neighbour analysis to check the distribution of the trees. This uses the formula:

$$Rn = \frac{\bar{D}(Obs)}{0.5\sqrt{\frac{a}{n}}}$$

Key:
Rn = nearest neighbour value
$\bar{D}(Obs)$ = mean observed nearest neighbour distance = 321cm
a = area under study = 20m x 20m = 400m^2
n = total number of points = 24

$$Rn = \frac{321}{0.5\sqrt{\frac{400}{24}}} = \frac{321}{0.5\sqrt{16.67}} = \frac{321}{0.5\ x\ 4.08} = \frac{321}{2.04} = 157.35$$

Conclusion

In this plantation there is no relationship between tree girth and distance to the nearest tree.

The mean age of the trees in my quadrat is 37 years, which ties in with the 1987 map.

Evaluation

The nearest neighbour result should lie between 0 and +2.15, where 0 indicates clusters of trees and +2.15 indicates a regular pattern (2). As we were working in a plantation our results should have been at the higher end but I couldn't get a result below +2.15 so must have made a mistake somewhere that I can't work out.

At least 30 trees should have been sampled to obtain a meaningful nearest neighbour analysis result. Our quadrat didn't include 30 trees so we should have made it bigger.

We rounded the girth measurements to the nearest cm, which could have had an impact on the mean.

We used a 1.5m long cane to make sure that all girths were measured at the same distance up the tree trunk. This means our results should be valid.

Reference

(1) A-Z Advancing Geography: Fieldwork textbook by Dave Holmes and Dave Fairbrother
(2) Barcelona Field Studies Centre https://biologyfieldwork.com/nearest_neighbour_analysis.htm accessed Feb 2019