Natural regeneration at different microclimatic sites in Žatec region

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ABSTRACT: Natural regeneration is an important part of close-to-nature forestry. However, natural regeneration also has either natural or technological limits. Among the most important natural limits are a low sum of precipitation and site type. The study concentrates on Žatec region where the long term average sum of precipitation is only 440–450 mm per year. Dry periods during the vegetation time are quite frequent. The study was conducted on clear cut area, stand edge, shelterwood area and stand interior. The results showed the highest population densities in a shelterwood system, the lowest in the stand interior. On the other hand, the dry seedling biomass is lower for seedlings from shelterwood area than from clear cut area.

Keywords: shelterwood system; clear cut system; natural regeneration; seedling population density; dry seedling biomass

Natural regeneration is a part of close-to-nature forestry. Close-to-nature forestry could be described as an ecological and technological system using ecological and natural forces without interruption for chosen goals (TESAŘ 1997).

Natural regeneration has many advantages (PEŘINA 1964) such as continuation of adopted tree ecotype, high number of seedlings creating a stable young stand in early stage, diversified structure in terms of species composition and stand interior, proper root system development and therefore better future tree stability, maintenance of high genetic diversity and economically more suitable regeneration of forest land. The root development is very often negatively influenced by planting (MAUER 1992). This is also true for containerized plants (STROMBERG 1998). On the other hand, there are shortages of natural regeneration as well. The main disadvantages are the limits for species composition, difficulties in silvicultural practices for less educated workers and long time span between the beginning and end of the regeneration process. The comparison of natural and artificial regeneration (ŠTOLL 1999) showed many advantages of natural regeneration.

Natural regeneration is a part of ecologically stable forest ecosystems. PODRÁZSKÝ (1998) described ecological stability as interior quality of forest ecosystems using their own mechanism to keep their consistency. POLENO (1997) stressed that the mechanism is either resistance (withstanding to changes) or resilience (capacity to come back to the original position). It should be stressed that the ecological stability has a dynamic character, it has nothing to do with static position.

Helsinki Conference on Forest Protection in Europe (1994) described sustainable forest management as the care of forests and forest land and their use in such a way to maintain their biodiversity, productivity, *regeneration,* vitality and ability to fulfill ecological, economic and social functions now and in future on a local, country and global level without damaging other ecosystems.

Natural regeneration is always a part of modern forestry. There are of course climatic and site limits that diminished the area where natural regeneration could be easily used. It is supposed that low sums of precipitation are usually less suitable for natural regeneration than areas with enough water supply for germinated plants.

RESEARCH AREA

The research area is in Žatec forests at the altitude of 250 m above sea level. The area is created by Pleistocene sand soil with clay overlay. Water erosion is strong within the area and that was very often the reason for afforestation. The area has a low sum of precipitation, i.e. 440–450 mm per year. An average temperature is 7–8.4°C. The main vegetation zone is the second one in the Czech typological system (dominant species are oak and beech). Vegetation period is about 160 days.

METHODOLOGY

The purpose of the study is to investigate how different natural regeneration systems could influence the survival and growth of seedlings in stands. The stand A is treated by a clear cutting regeneration system while the second stand B is under an irregular shelterwood system. The clear cut area of stand A is fenced with wooden fence of 1.7 m height to protect regeneration and other trees from game grazing. The clear cut area is between both stands in the position that the stand B edge is influenced by the clear cut area. In that way we could investigate not only the shelterwood system but also the edged clear cut system. In both stands the research transects were placed at the stand edges and inside of the stands in the following way:

Stand A:

– fenced clear cut area (transects No. 1 and 2 that are lying from clear cut into the stand edge),
– interior dense stand (transects No. 3 and 4).

Stand B:

– stand edge area (transects No. 5 and 6),
– shelterwood area (transects No. 7 and 8),
– interior dense stand (transects No. 9 and 10).

The transects are 1 m wide and their length is different depending on the type of investigated area. Transects 1, 2, 5 and 6 are 20 m long to cover both open and cover areas of the stand edges. The other transects inside of stands are only 10 m long. The investigated areas of transects are then 20 or 10 m^2, respectively. The transect areas were fixed with small wooden sticks and followed for two vegetation periods in 1999 and 2000. The transects were divided into regular 1 m^2 rectangles where all seedlings were measured in terms of height, diameter, age, species and type of damage. The investigations were done at the beginning and at the end of vegetation periods, altogether four measurements were executed. In that way we are able to follow also the survival rate of seedlings after winter time. At the end of investigations samples were taken into the laboratory where the weight of aboveground and ground biomass was measured in fresh and dry (after 24 hours of drying at the temperature of 105°).

As always two transects were identical in terms of regeneration systems, the data are summarized and the results given are the average transformed in number of seedlings per hectare.

The seedling age was followed in the three categories:

– this year seedlings,
– last year seedlings,
– more than two years old seedlings.

It was not always possible to indicate the age of older seedling when they were damaged by grazing and that is why the third age category is so broad.

There were in total 14 different species found on the transects. Damage was also recorded when measurements were done on transects.

Height increments were measured for each investigated period and standard deviations were calculated during data processing. The differences in the measured data were compared by *F*-test and *t*-test.

The mature tree crown cover was investigated on all transects. The crown of each tree was measured in 8 different directions and the crown area was calculated. An overlapping of the crown areas was taken into account. The year 1998 and 2000 were a good seed years for all species, namely for beech.

RESULTS AND DISCUSSION

The first stand A (transects No. 1–4) has rather low quality, i.e. acid beech and oak site with nearly pure beech stand (3K1, management unit 436) on a slope of south-east exposition. The second stand B is of the same site type (3K1) with the main species Norway spruce mixed with European beech, Scots pine and European larch (management unit 431). The stand is also on a moderate slope of north-west exposition.

Natural regeneration on clear cut areas is given in Tables 1 and 2.

The missing one year seedlings in the year 1999 in stand A (Table 1) are most probably the result of heavy weed competition on the clear cut area while in stand B the weed competition was not so harmful for seedlings. The rich seed crop of the next year (mainly beech nuts) is demonstrated by an increase of new seedlings on research plots. The data also shows the high density of natural regeneration even for the years with low seed crops when all living seedlings are counted (50,000 or 37,000). The

Table 1. Seedling density on clear cut area in stand A expressed in trees per hectare (the average for transects No. 1 and 2)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	0	0	15,000	5,000
Two year	11,500	8,500	0	0
Three and older	43,500	41,500	46,500	43,500
Total	55,000	50,000	61,500	48,500

Table 2. Seedling density on clear cut area in stand B expressed in trees per hectare (the average for transects No. 5 and 6)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	19,500	12,500	85,000	63,000
Two year	12,000	12,000	11,000	9,500
Three and older	13,500	12,500	22,000	21,500
Total	45,000	37,000	118,000	94,000

Table 3. Seedling survival on clear cut area at stand A in percentage (transects No. 1 and 2)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	–	33.3	–
Two year	73.9	–	–
Three and older	95.4	93.5	93.0

Table 4. Seedling survival on clear cut area at stand B in percentage (transects No. 5 and 6)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	64.1	74.1	–
Two year	100	86.4	88.0
Three and older	92.6	97.7	100

year after seed crops means double population density in the cases of stand B.

Interesting data on the survival of seedlings during vegetation periods and during winter are given in Tables 3 and 4.

The data shows that the critical period for seedling survival is the first vegetation period when the rate ranges between 33.3% to 74.1% for stand A and B, respectively. The older plants have a much higher chance to survive. This is true even for the winter period, when the percentage survival is from 88% to 100% (on average) for stands A and B, respectively. The results of the data given in Tables 3 and 4 show that the seedlings that survive the first year have a high chance to survive for a much longer period. The important fact that must be kept in mind is the clear cut area is fenced and thus game grazing is minimized.

Tables 5 and 6 below show the data on natural regeneration at the stand edge.

Both Tables 5 and 6 show large differences in seedling growth depending on the seed crops. While in the first year there were hardly any new seedlings, in the next year there were some ten thousands in the spring. The survival of seedlings is shown in Tables 7 and 8.

Table 5. Seedling density at the stand edge (A) expressed in trees per hectare (the average for transects No. 1 and 2)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	0	0	36,500	13,500
Two year	50,000	46,500	0	0
Three and older	3,000	2,500	42,500	37,000
Total	53,000	49,000	79,000	50,500

Table 6. Seedling density at the stand edge (B) expressed in trees per hectare (the average for transects No. 5 and 6)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	500	500	57,000	26,500
Two year	9,500	7,000	500	500
Three and older	18,000	17,500	22,000	22,000
Total	28,000	25,000	79,500	49,000

Table 7. Seedling survival at the stand edge (A) in percentage (transects No. 1 and 2)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	–	37.0	–
Two year	93.0	–	86.7
Three and older	83.3	87.1	–

Table 8. Seedling survival at the stand edge (B) in percentage (transects No. 5 and 6)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	100	46.5	100
Two year	73.7	100	89.8
Three and older	97.2	100	–

With the exception of the year 1999 in stand B where only few seedlings were growing and thus the data are not statistically sound, the survival of the first year seedlings is rather low (37% or 46.5%, respectively). If the seedlings survived the first year, then their probability to survive is much higher (73–97%). It could be concluded again the most critical was the first vegetation period until the root system of young seedlings reached the mineral soil.

Tables 9 and 10 give the information on natural regeneration under dense stand.

There is a clear difference between the open or edge area and the closed stand. While the first cases have more than 50,000 seedlings per hectare, under closed stand are "only" from 5,000 to 25,000 seedlings per hectare.

Seedling survivals are given in Tables 11 and 12.

There are not so large differences between the survival rate of one year seedlings and the older plants, as it is pronounced for clear cut area. It means the lower density at the beginning is compensated by a high survival in the next vegetation periods.

Finally, the data on the situation in a shelterwood system are given in Table 13.

The rich seed crop is documented by the data again. The main difference between the shelterwood system and clear cut system is the high seedling survival after the first year. The high seedling survival results in a high number of seedlings in the shelterwood system, in our case from 240,000 to 333,000 per hectare. Seedling density is significantly higher in the shelterwood system than in any other regeneration system in this study.

Seedling survival in the shelterwood system is given in Table 14.

Seedling survival is clearly significantly higher for the shelterwood system as follows from Table 14. An exception was the vegetation period 2000, when the survival rate amounted to 65.7% only. But one has to keep in mind that the high spring seedling density resulting from the rich seed crop in 1999 started much earlier before the competition reduced the one-year seedling population. The total seedling survival is satisfactory as it is about 90% on average.

Table 9. Seedling density in the stand interior (A) expressed in trees per hectare (the average for transects No. 3 and 4)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	0	0	3,500	2,500
Two year	9,500	5,500	0	0
Three and older	0	0	5,000	3,500
Total	9,500	5,500	8,500	6,000

Table 10. Seedling density in the stand interior (B) expressed in trees per hectare (the average for transects No. 9 and 10)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	1,000	500	14,500	7,000
Two year	13,500	10,500	0	0
Three and older	9,000	8,000	18,500	18,000
Total	23,500	19,000	33,000	25,000

Table 11. Seedling survival in stand A in percentage (transects No. 3 and 4)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	–	71.4	–
Two year	57.9	–	–
Three and older	–	70.0	90.1

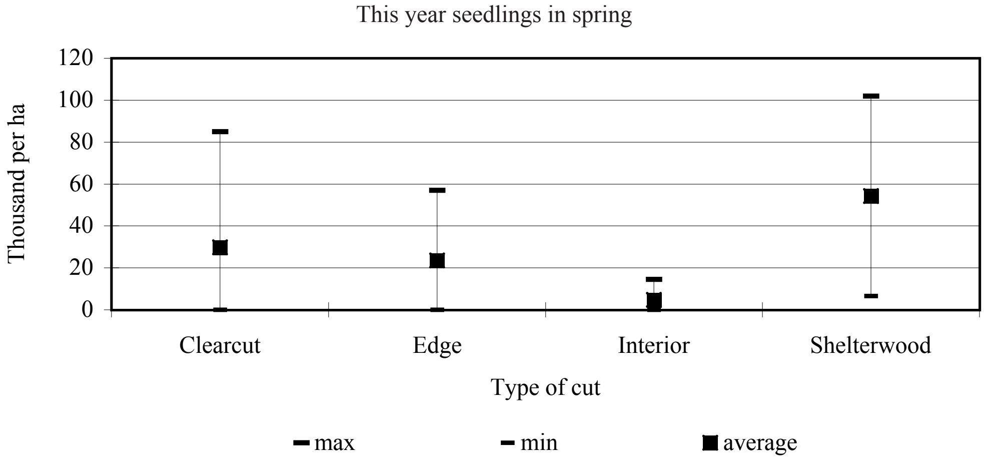

Fig. 1. The number of germinating seedlings in spring at different microclimate sites

Fig. 1 shows clear differences in densities of germinating seedlings in spring. The most preferable is the shelterwood system that creates on average more than 50,000 seedlings per hectare while the stand interior is worse for germination. Clear cut area and stand edge are basically the same in terms of seed germination.

The difference between different microclimatic types in terms of total seedlings in spring is much more pronounced (see Fig. 2). While the total number of seedlings per hectare on the clear cut area is about 70,000 seedlings and nearly the same density is on the stand edge, the seedling number on the shelterwood cut area is four times higher (about 300,000 seedlings per ha). The number of seedlings in the stand interior is lower than it could be expected.

The species composition of natural regeneration is strongly influenced by the species composition of mature stand. Beech is the main species in stand A both in mature stand and in natural regeneration but on the clear cut area there are also pioneer species such as birch and aspen. There are no significant differences in seedling survival for the different species in these early stages in the whole

Table 12. Seedling survival in stand B in percentage (transects No. 9 and 10)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	50.0	48.3	0
Two year	77.7	–	100
Three and older	–	70.0	–

Table 13. Seedling density in a shelterwood system in stand B expressed in trees per hectare (the average for transects No. 7 and 8)

Seedling age	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
One year	6,500	6,000	102,000	67,000
Two year	81,000	77,500	4,500	4,500
Three and older	163,500	156,000	226,500	218,000
Total	251,000	239,500	333,000	289,500

Table 14. Seedling survival in a shelterwood system in stand B in percentage (transects No. 7 and 8)

Seedling age	Vegetation period 1999	Vegetation period 2000	Winter 1999–2000
One year	92.3	65.7	75.0
Two year	95.7	100	–
Three and older	95.7	86.9	96.8

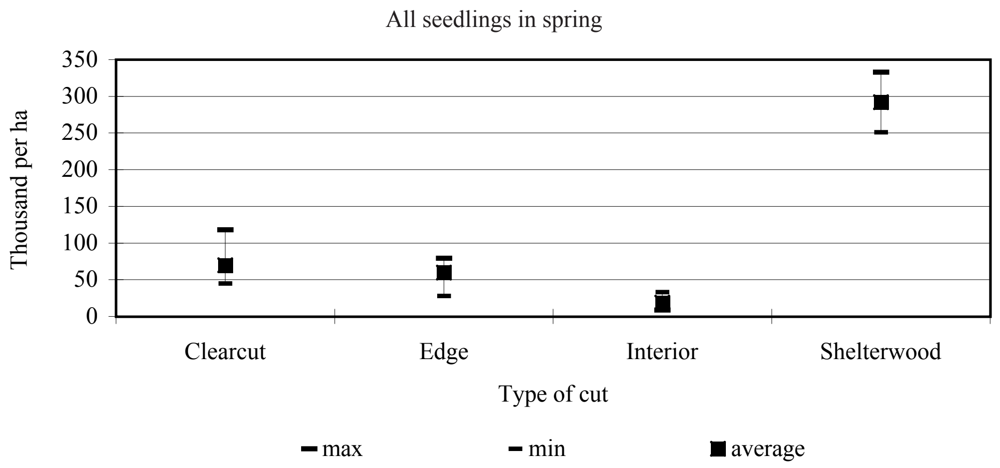

Fig. 2. The number of all age seedlings in spring for different microclimatic types

period of investigations. The species composition of natural regeneration on the different microclimatic sites are given in Tables 15 to 18.

The data on damage to seedlings were collected as well. The most important aspect is the influence of a fence on damage in stand A in comparison with stand B without fence (see Tables 19 and 20).

The results are not such as they could be expected. In the first year damage on the fenced clear cut area is smaller but not significantly, in the next year the results are just opposite

Table 15. Species composition of natural regeneration in the clear cut area in transects No. 1, 2 in stand A in trees per hectare

Species	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Beech	40,500	37,000	50,000	39,000
Aspen	7,000	7,000	6,000	5,000
Birch	4,500	3,500	3,000	2,000
Willow	500	500	500	500
Pine	2,000	2,000	2,000	2,000

Table 16. Species composition of natural regeneration in the stand edge in transects No. 5, 6 in stand B in trees per hectare

Species	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Beech	17,000	15,000	61,000	35,000
Birch	1,000	1,000	1,000	500
Acer	1,500	1,000	6,500	2,500
Spruce	8,000	7,500	9,000	9,000
Pine	0	0	500	500
Larch	500	500	1,500	1,500

Table 17. Species composition of natural regeneration in the stand interior in transects No. 9, 10 in stand B in trees per hectare

Species	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Beech	20,000	18,000	30,000	23,500
Acer	3,000	1,000	3,000	1,500
Birch	500	0	0	0

Table 18. Species composition of natural regeneration in shelterwood in transects No. 7, 8 in stand B in trees per hectare

Species	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Acer	222,500	212,500	289,000	253,500
Beech	24,000	23,500	40,500	33,000
Elm	1,500	1,500	1,500	1,500
Rowan	1,500	1,500	1,000	1,000
Spruce	1,500	1,000	1,000	500

Table 19. Damaged and undamaged seedlings on a fenced clear cut area in percentage in transects No. 1, 2 in stand A

Type	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Undamaged	85.5	73.0	69.1	70.1
Damaged	14.5	27.0	30.9	29.9

Table 20. Damaged and undamaged seedlings on an unfenced clear cut area in percentage in transects No. 5, 6 in stand B

Type	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Undamaged	75.5	64.9	88.6	85.1
Damaged	24.5	35.1	11.4	14.9

when a rich seedling crop was present. The total average of undamaged seedlings is even higher (78%) on the unfenced clear cut area (stand A) than on the fenced clear cut area (stand B) where the average is 74.4%. Table 21shows damage in the shelterwood system (stand B).

The seedlings are highly damaged by grazing on the shelterwood area where about a half of the seedlings are damaged. Even the seedling density is high, the question is how the natural regeneration could sustain the high pressure of grazing. The damage is much higher than on the clear cut area (Table 20), which is probably influenced by game ethology (roe deer preferred covered area to the open clear cut area).

A part of research was to investigate if there are any differences in dry biomass of seedlings growing on the clear cut area, i.e. in full sunshine, and in shelterwood, i.e. as shade tolerant species. Tables 22 and 23 give the data on ground and aboveground dry biomass for seedlings in different microclimate.

Significant differences are in the root system of one year seedlings (see Table 22). One year seedlings on the clear cut area under full sunshine conditions have significantly higher (nearly twice) root biomass than seedlings growing in shade. A similar situation is likely for aboveground biomass but the differences are not significant.

Table 21. Damaged and undamaged seedlings on the shelterwood area in percentage in transects No. 7, 8 in stand B

Type	Spring 1999	Autumn 1999	Spring 2000	Autumn 2000
Undamaged	58.6	38.3	47.7	42.0
Damaged	41.4	61.7	52.3	58.0

Table 22. Dry one-year seedling biomass in different microclimate (in g)

	Clear cut area(1)		Stand edge(2)		Shelterwood(3)	
	average	variation	average	variation	average	variation
Aboveground biomass	0.1259	0.0024	0.0958	0.0025	0.0833	0.0014
Ground biomass (roots)	0.1964*	0.0093	0.0969*	0.0032	0.0920*	0.0031

Notes: Number of cases: (1) n = 11, (2) = 12, (3) = 10
*Significant differences on the level 0.95

Table 23. Dry biomass of more than two years old seedling in different microclimate (in g)

	Clear cut area(1)		Stand edge(2)		Shelterwood(3)	
	average	variation	average	variation	average	variation
Aboveground biomass	1.2729*	0.3373	0.5863*	0.0926	0.2330*	0.0078
Ground biomass (roots)	1.4454*	0.4452	0.9752*	0.2198	0.3228*	0.0147

Notes: Number of cases: (1) n = 11, (2) = 11, (3) = 12
*Significant differences on the level 0.95

Table 23 gives the data on older (more than two years) seedlings.

The older seedlings are significantly different both in aboveground and ground biomass. The most robust are seedlings on the clear cut area, i.e. in full sunshine conditions, the smallest seedlings are in the shelterwood regeneration system, i.e. growing in shade conditions.

CONCLUSIONS

Natural regeneration in forest areas with low precipitation sum in the vegetation period is not very often successful. This study investigated the development of natural regeneration from the very beginning in such a dry area. The altitude of research area is 250 m above sea level, the long-term average annual temperature is 8.4°C but very often it is above 10°C (for the year 1999 it was 10.2°C). The long-term average precipitation sum is 441 mm per year but very often the precipitation is even lower (for the year 1999 it was 428 mm per year). The vegetation period has the average temperature 16°C and the average precipitation is only 250 mm. The original forest species composition was mainly oak (45%) followed by beech (35%) with some pine (9%) and white fir (5%). The actual species composition is made by Scots pine (60%) or Norway spruce with mixed broadleaves species (oak, beech, lime, hornbeam, etc.).

The results show the seed crop even in not rich years gives enough seed enabling natural regeneration. Germination is successful giving 15,000 new seedlings per hectare in the spring with low seed crop while in the rich seed crop year the number of new seedlings per hectare easily exceeds 50,000 on clear cut areas. Nearly the same amounts could be found at the stand edge or on shelterwood areas which seems to be slightly the most rich in terms of new germinated seedlings in spring. The total amount of all seedlings is much higher when accounted older seedlings together. The total amount ranges from 50,000 to 300,000 seedlings per hectare. These amounts exceed the tree number planted in artificial regeneration and the amount requested by Czech forest regulations many times.

The first year of seedlings is the most critical one for their future existence. A survival rate for the first year seedlings at the beginning (in spring) is rather low (33–37%) on the clear cut area while it is higher on the protected area (stand interior and shelterwood area have the survival rate of 66–92%). When seedlings survive the first vegetation period, their probability of longer existence substantially increases. Their survival rate in winter time is surprisingly higher than in spring. The next year when their root system is established, their survival is quite high (50–100%). There is no basic difference in older seedling survival at different microclimate sites, i.e. between clear cut area, stand interior or shelterwood area. As a result of these processes, the total number of seedlings is much higher on shelterwood area than on clear cut or stand edge areas. The stand interior has the lowest amount of seedlings if compared with clear cut, stand edge or shelterwood areas.

The most damaged seedlings are on shelterwood areas by game grazing. It is the result of game ethology when the animals prefer covered areas with rich supply of plants for grazing.

The microclimate conditions clearly influenced the seedling growth. The biomass of one year seedlings was statistically significantly different for seedlings from clear cut area and shelterwood area. The seedlings from the clear cut area have significantly higher biomass both in aboveground parts of plant and in the root system as well. The results are the same for older plants when seedlings from clear cut areas keep the advantages in terms of dry biomass both in aboveground and ground parts.

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Vliv mikroklimatu na přirozenou obnovu v oblasti Žatecka

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ABSTRAKT: Přirozené zmlazení je důležitou součástí přírodě blízkého hospodaření v lesích. Má však také svá omezení – ať už technologická, či přírodní. Mezi přirozené limity patří nízké srážky a neúrodnost stanoviště. Studie se soustředila na žateckou oblast, která je charakteristická nízkými srážkami (440–450 mm za rok) a častými periodami sucha ve vegetačním období. Studie sledovala přirozené zmlazení na holoseči, okraji porostu, clonné seči a uvnitř porostu. Výsledky prokázaly, že nejhustší populace semenáčků se vytváří v clonné seči, nejnižší je pod zapojeným porostem. Na druhé straně mají semenáčky z otevřené plochy signifikantně vyšší hmotnost suché biomasy než semenáčky z clonné seče.

Klíčová slova: clonná seč; holoseč; přirozená obnova; hustota semenáčků; biomasa semenáčků

Přirozená obnova lesa je důležitou součástí moderního pojetí lesního hospodářství, ať už ho nazýváme jako přírodě blízké nebo trvale udržitelné. Přirozená obnova lesa má řadu předností, z nichž nejdůležitější je zachování a udržování existence místního ekotypu dřevin, vysoký počet jedinců v náletu, dávající záruku dalšího pozitivního vývoje mladého porostu, diverzifikace vnitřní struktury porostu, zdárný a nedeformovaný vývoj kořenového systému a zachování biologické a genetické diverzity lesů. Řada autorů uvádí konkrétní data o přednostech přirozené obnovy (Peřina 1964; Mauer 1992; Stromberg 1998; Štoll 1999). Přirozená obnova přispívá k vyšší stabilitě lesních ekosystémů (Podrázský 1998; Poleno 1997).

Přirozená obnova má samozřejmě i své limity, a to jak z hlediska provozního, tak i z hlediska přírodních podmínek. Nižší srážky jsou obecně považovány za jeden z těchto limitujících přírodních faktorů. To byl důvod ke zpracování této studie v oblasti LS Žatec, která je jednou z nejsušších oblastí naší republiky. Tato oblast se nachází v nadmořské výšce kolem 250 m n. m. a srážkový úhrn činí pouze 440–450 mm za rok. Dlouhodobý průměr roční teploty v tomto regionu činí 8,4 °C. Tato oblast spadá podle českého typologického systému do druhého a třetího lesního vegetačního stupně bukových doubrav a dubových bučin s délkou vegetační sezony asi 160 dnů. Převažujícím lesním typem na sledovaných transektech je 3K1, patřící do kyselých chudých bučin.

V rámci studie byly vytvořeny dvě výzkumné plochy (označené jako plochy A, B). První porost (A) je obnovován okrajovou holou sečí. Druhý porost (B) je obnovován nepravidelnou clonnou sečí vzniklou nahodilou těžbou uvnitř porostu. V rámci obou výzkumných ploch bylo vytyčeno celkem deset transektů širokých 1 m a dlouhých buď 10 m, nebo 20 m. Plocha A se nachází na okraji paseky v oplocence a okraji porostu. Zde byly vytyčeny transekty č. 1 a 2 dlouhé 20 m zasahující z holé plochy až do okraje porostu. Další kratší desetimetrové transekty byly vytyčeny uvnitř tohoto porostu (označené čísly 3 a 4). V druhém porostu (B) jsou vytyčeny transekty 5 a 6 na okraji porostu, 7 a 8 v clonné seči a 9 a 10 uvnitř porostu. Každý transekt byl rozdělen na jednotlivé m^2 a v každém byl samostatně sledován vývoj semenáčků, jejich velikost, věk, druh a stupeň poškození. Měření bylo prováděno na počátku a na konci dvou vegetačních sezon, celkem tedy byla provedena čtyři měření. Tyto údaje umožňují sledovat vývoj přirozené obnovy a přežívání semenáčků nejen během vegetace, ale i jejich životnost přes zimní období. Na konci šetření byly odebrány vzorky jednoletých a víceletých semenáčků buku z plochy holé seče i z místa clonné seče a v laboratoři byla zjištěna jejich suchá biomasa zvlášť pro nadzemní část a kořenový systém. Na transektech uvnitř porostu a na clonné seči byly změřeny korunové projekce stromů mateřského porostu, aby mohl být porovnán stupeň zastínění plochy transektů. Rok před prováděným měřením byl poměrně bohatý na úrodu semen a lze ho označit za semenný rok.

Výsledky šetření jsou uváděny v tabulkách. Přirozené zmlazení na holoseči v porostu A je v tab. 1, v porostu B v tab. 2. Zajímavé jsou značné rozdíly na obou plochách v prvním roce sledování u jednoletých semenáčků. Přes tento rozdíl v jednoletých semenáčcích není celkový počet všech semenáčků nějak výrazně rozdílný. Důležité jsou tab. 3 a 4, které uvádějí přežívání semenáčků. Z tabulek je zřejmé, že nejvyšší mortalita se vyskytuje v prvním roce existence semenáčků, a to zejména v období vegetační sezony. Potvrzuje se, že v období, kdy semenáčky nemají ještě dostatečně vyvinutý hluboký kořenový systém, dochází během krátkých suchých period k velké redukci jejich počtu. Procento přežití je vyšší i v zimním období, porovnáváme-li ho s mortalitou během první vegetační sezony. Výsledky šetření rovněž potvrdily velké rozdíly v hustotě přirozeného zmlazení na otevřené ploše a pod porostem. V normálně zapojeném porostu je hustota semenáčků nejméně čtyřikrát nižší než na volné ploše, a ta je opět asi pětkrát nižší než na ploše obnovované clonně (obr. 1 a 2).

Škody zvěří byly nejvýraznější na ploše obnovované clonně, což je bezpochyby způsobeno etologií zvěře, která vyhledává krytá místa. Nepříznivě se pravděpodobně projevila i bohatá nabídka pastvy na této ploše. Při porovnání škod uvnitř a vně oplocenky se neprojevily žádné podstatné rozdíly v redukci škod. Potvrzuje se obtížnost dlouhodobého udržení dobře uzavřené oplocenky, která by zajistila skutečnou ochranu sazenic před zvěří.

Výsledky porovnání hmotnosti biomasy víceletých semenáčků ukázaly, že jak nadzemní část, tak i kořenový systém semenáčků na otevřené ploše je signifikantně vyšší než biomasa nadzemní části a kořenového systému semenáčků pod porostem. U letošních semenáčků byly tyto rozdíly signifikantní jen pro kořenový systém, v nadzemní části se tyto rozdíly ještě výrazněji neprojevily.

Výsledky šetření v oblasti Žatecka potvrdily, že i v semiaridních oblastech lze dosáhnout dostatečné přirozené obnovy lesa s takovou hustotou semenáčků, která dává předpoklady pro vytvoření následného porostu. To platí zejména pro roky s poměrně vyšší úrodou semen. Nejkritičtější je první vegetační období, během kterého se počet vyklíčených semenáčků nejvíce redukuje. Pokud přežijí semenáčky první rok, je jejich naděje na přežití poměrně vysoká. Studie potvrdila signifikantní rozdíly v hmotnosti biomasy semenáčků rostoucích na otevřené ploše a pod mateřským porostem.

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