The Commons of Rejnstrup, Denmark

The exploitation of marginal land from antiquity
to present time and its influence on the vegetation

By VALD. M. MIKKELSEN

Biologiske Skrifter **33**

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Abstract

The soil of Rejnstrup Common is sandy and very rich in stones and boulders making cultivation difficult.

Archaeological and palynological investigations together with studies of archives elucidate the history of the vegetation and the different ways farmers have exploited the area (totally 190 ha) from Neolithic to recent time: as cultivated fields, commons, pasture, pannage, as deer-park, and for forestry.

Several forest-clearings and reforestations have taken place. The "Forest-Ordinance of 1805" divided the area in protected forest and farmland. The latter today contains cultivated fields, plantations and commons.

The recent vegetation is studied in two remaining commons. Shrubs were mapped in 1958 and 1986. Airphotos are accessible from 1954, 1974, and 1986. A few analyses of the ground vegetation were made in 1919 and 1941 and in 1986 a more intensive investigation took place.

One lot has been part of a deer-park since 1888 and is almost without shrubs, and many of the species characteristic of Danish commons and slopes still grow there. The other lot was grazed by cattle from 1808 to 1983 and has been manured with lime and fertilizer since the 1940'ies. It is strongly overgrown with spiny shrubs, but there is no sign of reforestation. The characteristic species of the common have disappeared or become sparse after the 1940'ies, because they have been unable to compete with more eutrophic species favoured by the manuring.

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KEY WORDS:

Forest-clearing, cultivated fields, commons, cattle-grazing, pasture, pannage, deer-park, red deer, *Calluna vulgaris, Crataegus sp., Rosa sp., Sambucus nigra, Prunus spinosa, Urtica dioeca,* liming and fertilization of natural vegetation.

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Contents

Introduction

Rejnstrup Overdrev (The Commons of Rejnstrup) is situated south of Lake Tystrup in South Zealand (fig. 1). The area has been thoroughly investigated. Archaeology and history have been treated by Steensberg (1968, 1983a and b), the development of vegetation by Mikkelsen (1986), the recent overgrowing and its history by Mikkelsen, Dyhre Rasmussen, and Steensberg (1986).

Fig. 1. Location map.

The area is called Rejnstrup Overdrev, but the village Rejnstrup has not been the only user of the pastures. The western part of the area was exploited by the village Borup from AD 700 till the abolition of this village about AD 1000. Then it was used by a demesne farm till about AD 1200. Since that time the area was used by the village Rejnstrup. During the 15' and the beginning of the 16' century the manor Gunderslevholm took possession of the main part of the area and afterwards it was used by the farms in Rejnstrup and Gunderslevlille belonging to the manor.

Rejnstrup Overdrev consists of several lots. The map (fig. 2) shows the lots and their present names. On older maps and in the archives these and other names have been used and sometimes covering different areas making the studies of the archives difficult. As will be shown below grazing was an important use of the area, but during the period of about 6000 years parts of the area were exploited in many different ways.

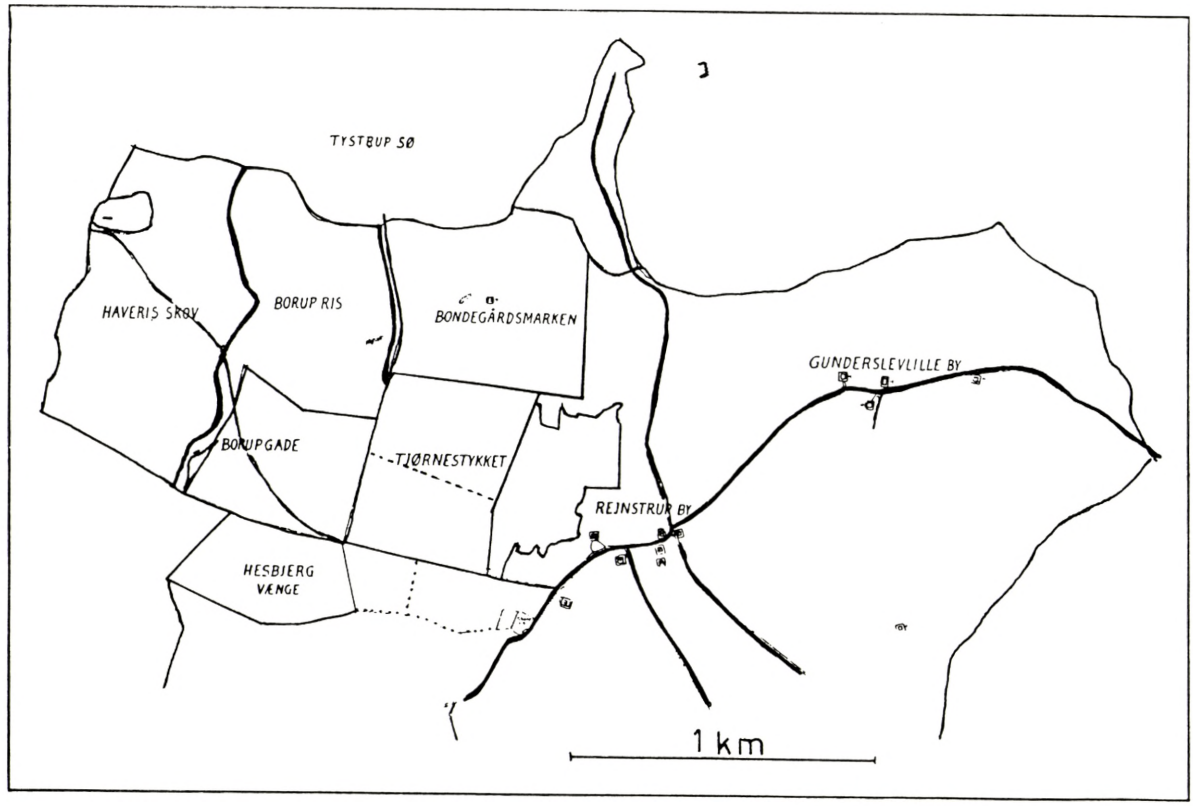
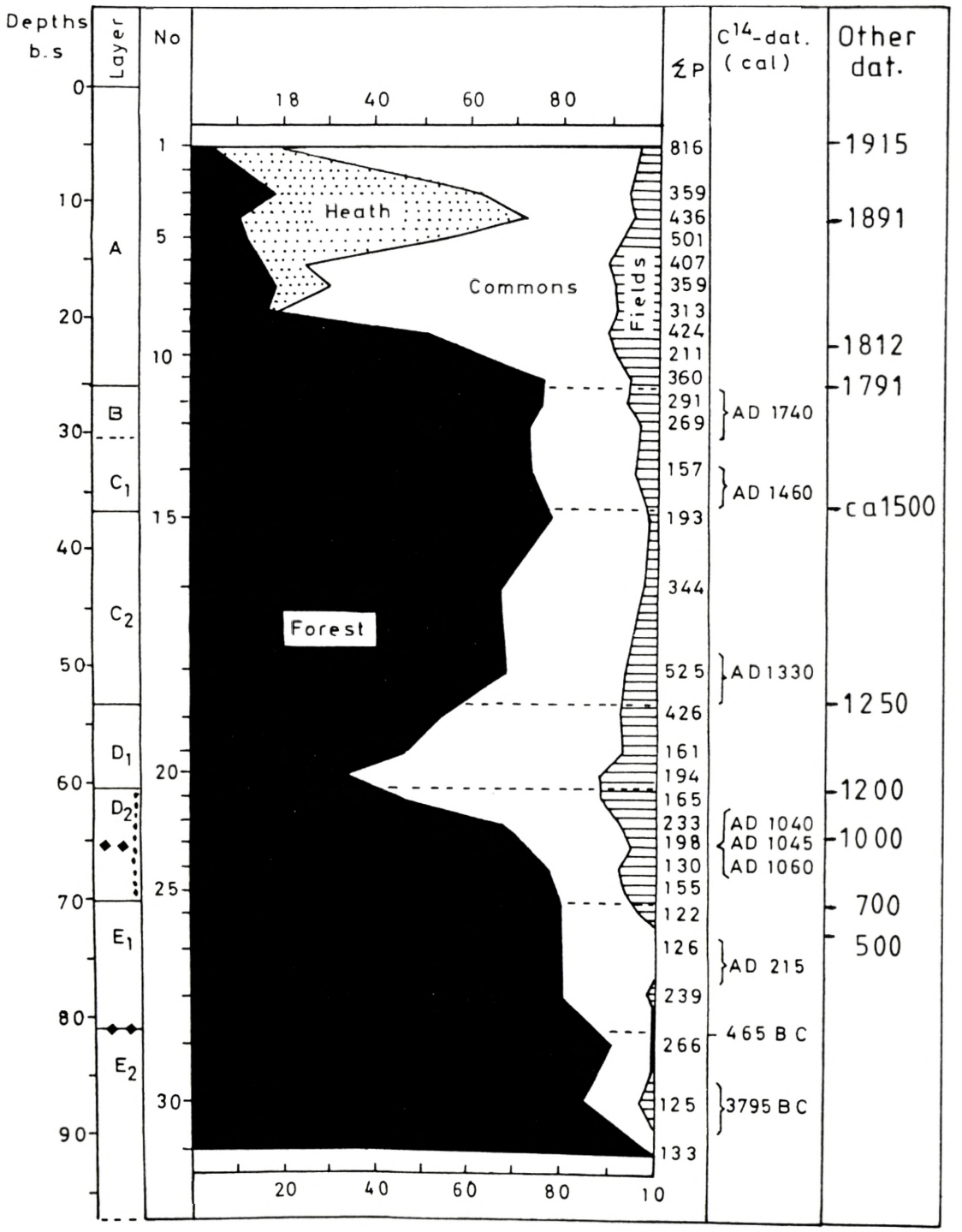


Fig. 2. Map showing the individual lots of Rejnstrup Overdrev, drawn by Axel Steensberg.

Informative sources

A survey pollen diagram (fig. 3) from the bog Tyste Mose situated in the southeastern corner of Borup Gade (cf. fig. 2 and 12) gives informations on the relation between forest and open land (fields, commons, heath) from Neolithic time to the beginning of the 20' century. A more detailed pollen diagram was discussed in Mikkelsen 1986. From antiquity onward this information is supplemented by Steensberg's archaeological investigations (Steensberg et al. 1968, Steensberg 1983a, 1983b). From about AD 1400 we have the first documents concerning the area. In the beginning the information found in the archives is sparse, but from about 1800 the archives of the manor are rich in information, e.g. a detailed map from 1791 (Steensberg et al. 1968, fig. 3). Airphotos of the area were taken in 1954, 1974 and 1986.

Fig. 3. Survey pollen diagram (from Mikkelsen, 1986) showing the relations between the areas of forest, commons, heath, and fields from Neolithic to recent time.


Depths b.s
Layer
No
18 40 60 80
ΣP
C14-dat. (cal)
Other dat.
Heath
Commons
Fields
Forest
A
B
C1
C2
D1
D2
E1
E2
816
359
436
501
407
359
313
424
211
360
291
269
157
193
344
525
426
161
194
165
233
198
130
155
122
126
239
266
125
133
AD 1740
AD 1460
AD1330
AD 1040
AD 1045
AD 1060
AD 215
465 B C
3795 B C
1915
1891
1812
1791
ca1500
1250
1200
1000
700
500
20 40 60 80 10

In 1958 the late Dyhre Rasmussen mapped and examined the shrubs in Tjørnestykket (cf. fig. 2) and in a part of Borup Gade. In 1986 Steensberg and Mikkelsen repeated these investigations in a part of Tjørnestykket and made analyses of the ground vegetation in Tjørnestykket and Borup Gade (Mikkelsen, Dyhre Rasmussen and Steensberg 1986).

The exploitation of Rejnstrup Commons from antiquity to the present

Exploitation and vegetation before the "Forest-Ordinance" of 1805

The soil of Rejnstrup Overdrev is sandy and very rich in stones and boulders rendering cultivation very difficult. Even if the area is and always has been typical marginal land, through the ages it has been used by the farmers in different ways.

Information on the history and vegetation of the area before agriculture was introduced to Denmark about 4000 BC is missing, but a comparison with the development elsewhere in Denmark makes it justifiable to believe that the area was covered with natural forest of lime and oak.

NEOLITHIC TIMES. About 3800 BC the pollen diagram shows that parts of the area were cleared and cultivated. The dolmens in the area confirm this. Furthermore Steensberg found some evidence of an occupation in the village area about 2000-1800 BC.

BRONZE AGE. Between 1800 BC and 925 BC Steensberg found no remains of occupation. Charcoal from a cooking-pit without any remains of pottery or other artefacts showed that people had been there, but gave no evidence of occupation.

The pollen spectrum dated between 3800 BC and 465 BC shows an increase of *Tilia* and *Quercus*, a decrease of *Corylus*, and no weeds, which may indicate a regeneration of the forest in the period of the Bronze Age without occupation.

In the late Bronze Age (about 700 BC) there is some evidence of occupation, but there is no proof of continuous settlement from this time until the Pre-Roman Iron Age.

IRON AGE. According to the pollen diagram clearings for cultivation were made about 500 BC. This occupation is confirmed by the results of Steensberg's excavations i.a. the "Celtic Fields". All datings of Steensberg belong to the period before BC, and it is the opinion of Steensberg that the area was unoccupied from the 2nd to the 7th century AD.

The pollen diagram indicates that before AD 500 the forest began to regenerate (increasing *Quercus*, *Fagus*, and *Fraxinus* together with decrease of *Corylus* and dissappearance of cereals and *Artemisia*). In these centuries without occupation undoubtedly the forest covered great parts of the area. The structure of the forest had changed as lime became more sparse and the dominating trees were oak, and especially after AD 500, beech.

THE VILLAGE BORUP (AD 700-AD 1000). The peat layers in the section of Tyste Mose dated earlier than AD 700 and the layers after that time are separated by a very thin layer similar to the layers of ashes found in the surroundings of an earlier fireplace in the bog. Furthermore the peat from the period after AD 700 contains microscopic charcoal. The pollen diagram shows slightly decreasing values of *Quercus* and *Fagus* together with increasing values for *Cerealia*, *Rumex*, *Artemisia*, and *Pteridium* which may indicate a clearing in the forest at the same time as the foundation of the village Borup in

the western part of Borup Gade. The clearing of the forest is more weakly indicated in the pollen diagram than the following about AD 1000 because the cleared areas were situated father away from the pollen profile in Tyste Mose, cf. Mikkelsen 1986, fig. 11.

The fields of the village (about 40 ha) covered Borup Ris, and a considerable part of Borup Gade was used as common (Steensberg 1983b, fig. 11).

According to Steensberg the village Borup was founded by people from Bavelse independently of the foundation of the village Rejnstrup, undoubtedly from the same time.

THE DEMESNE FARM (AD 1000-AD 1200). About AD 1000 a single man took possession of all the farms in Borup and built the demesne farm in the middle of Borup Gade. Charcoal of beech in Tyste Mose and the pollen diagram (Mikkelsen 1986, fig. 5) show that beech forest in the eastern part of Borup Gade was cleared. This beech forest undoubtedly separated the common of Borup from the common of Rejnstrup during the time of the village. After about AD 1000 most of Borup Gade was transformed into cultivated fields. The fields of the demesne farm covering about 50 ha was separated from the village Rejnstrup by a still existing dike along the border between Borup Gade and Tjørnestykket.

AD 1200-1700. About AD 1200 the demesne farm was deserted, but the cultivation of its fields continued from Rejnstrup. The pollen diagram (fig. 3) shows that the open land (mostly commons) increased to about 60 % of the total area during the first decades of the 13' century, and most likely the new clearing was the forest in Tjørnestykket separating this lot from Rejnstrup. During this period most of Rejnstrup Overdrev was open land, either cultivated fields or pastures grazed by the livestock from the farms of Rejnstrup. Undoubtedly Haveris Skov was part of the commons at the beginning of the 13' century and had been so since the time of Borup. An indication of this was a big oak called Borup Kirke (the church of Borup) felled in a tempest in 1974. The oak had a diameter of 3 m and was estimated to be about 800 years old. It had a big bough about 2 m above the ground indicating that it had grown up in open land, e.g. a common (Steensberg 1983a, fig. 78).

Cattle grazing and clearings were, however, not sufficient to keep shrubs and trees away. Already before AD 1250 when according to Steensberg most of the fields in the area were abandoned, shrubs and trees had begun to conquer the commons. According to the pollen diagram open land covered about 40 % of the area about Ad 1250 and from about AD 1500 to 1781 only 25 % was open land.

Tyste Mose and its surrounding wetlands were part of the open land, but furthermore an area of about 10 ha in the western part of Borup Gade was undoubtedly unforested. The map of 1791 shows this area covered with grass. The area includes i.a. the tofts of the deserted village. These were more fertile and offered better grazing than the rest of Borup Gade and might therefore have been preferred by the herdsman of Rejnstrup who undoubtedly, as it was common elsewhere in Denmark (Steensberg 1982a, page 174f.), guarded the cattle of the village. The archaeological investigations (Steensberg 1983a) furthermore show that the area had been used as a place of worship from before AD 700 to at least about AD 1500, and as late as in the close of the 19' century the youth of Rejnstrup used it for dancing in the summer time. A good indication of its being open land in the first half of the 18' century is the shape of Dansebøgen (the dancers' beech) which grew in the old cult-place in Borup Gade from about 1730 to 1967 (Steensberg 1983b and 1983a, fig. 2).

Shortly after AD 1200 hazel began its spreading on the rest of the area, and after about AD 1250 oak was spreading both in the hazel scrubs and on the grassland. The scrubs furthermore made it possible for beech to germinate and develop. The increase of beech indicates that only the open area was influenced by cattle, while pigs must have been the most common domestic animal in the rest of the commons. Documents from the first decade of the 15' century show that the area was then used for pannage (Steensberg et al. 1968). About AD 1500 the main part of Rejnstrup Overdrev was covered

with forest containing oak, beech, and hazel.

After AD 1500 the composition of the forest changed as beech now became the dominant tree. The climatic change (the "Little Ice Age") may have been of some influence, but the main reason must have been that from now on pigs fed on mast became the essential agricultural use of the area. Pigs further to, while cattle prevent the establishement of beech forest (cf. Bjerke 1957).

The increasing influence of pannage is undoubtedly connected with the fact that the manor Gunderslevholm by this time had acquired most of the area. In the 16' century 10 farms in Rejnstrup had to pay a fee to the manor equalling to the pannage of 60 pigs. The main interests of the manor in the forest were thus timber, hunting, and pannage, and the last favours beech.

AFTER AD 1700. It is not known when pannage ceased in the area, but during the first half of the 18' century a new generation of beech germinated and some of these trees were still alive in the 1950'es. A drawing from 1862 of one of the dolmens in Borup Ris (Steensberg 1983a, fig. 4) also shows beeches some of which according to recently counted annual rings germinated about AD 1700.

About 1750 pannage was wholly or partly replaced by cattle grazing. According to a letter of January 25th 1758, 17½ farms in Rejnstrup and Gunderslevlille are each allowed to graze 8 "store høveder" in the grazing-fields belonging to the manor. Ther term "store høveder" (= large head of cattle) is a unit used in the 18' century e.g. when pastures were shared by several farms (Steensberg 1982b, page 308). One "høved" signified a full-grown cow or oxen (3 years or older) and could be substituted by ½ two years old or 2 one year old heifers or ⅔ horse. The animals grazing in the commons were mostly heifers and a few horses. The area in which the 140 "høveder" were grazing included all the lots in the map (fig. 2), totally about 190 ha. According to the pollen diagram and the map from 1791 this area was covered with forest except for 10 ha in the western part of Borup Gade.

Notes on the map, dating from approximately 1805, shows that at this time 8 of the farms were allowed to graze 8 "høveder" each in the area and 6 other farms 6 "høveder" each, in all 100 head of large cattle, or the equivalent number of heifers.

Extent and use of the commons after 1808 and development of the vegetation

The "Forest-Ordinance of 1805" and the almost contemporaneous allotment of the farms meant a very great change in the exploitation of the area.

In 1812 Haveris Skov and Borup Ris became protected forest and were fenced. The forest in the other lots was felled and afterwards these areas became part of the farmland.

Table 1 shows the areas used for common grazing during different periods and the number of head of large cattle, mostly replaced by the proportional number of heifers and horses, grazing in the pastures. As an indication of the grazing stress the table gives the number of ha per head of large cattle.

1808-1874. December 3rd 1808 the farmers of the two villages had to give up the common grazing in the two protected forests Haveris Skov and Borup Ris, and Bondegårdsmarken was given to an outlying farm. So the area of common grazing decreased to 67 ha (Tjørnestykket, Hesbjerg Vænge, and Borup Gade). On this area the forest was felled and this is also clearly illustrated in the pollen diagram (fig. 3, samples no. 10 to 8). The grazing in these 67 ha was shared by 12 farms which in 1808 and undoubtedly also later could send each 6 to 8 head of large cattle on the common, a total of between 72 and 84 leaving 0.8-0.9 ha for each "høved". Compared with the 1.9 ha before 1808 this seems a reduction, but then the area was open grassland, while earlier it was forest.

In 1874 the farm on Bondegårdsmarken was given up and its fields included in the area for common grazing which therefore increased to about 103 ha (1.2-1.4 ha per head of large cattle). In 1866 a deer park with red deer and fallow deer was estab-

lished in Haveris Skov and Borup Ris. In 1886 Borup Gade was included in the deer park whereby the area of pasture decreased to about 81 ha. A few small-holders still hired grazing in the deer park for some few head of cattle, while the 12 farms in the villages shared the grazing on the commons. This common grazing lasted until 1922. The farmers alternately had the task of alderman whose duty was to manage the start of the common grazing, the veterinary control, the fencing etc. An old farmer of Rejnstrup has reported that each farm in the summer could send 5-6 heifers, or instead of 2 heifers a horse to the commons. Thus between 60 and 72 heifers were grazing in the commons. As a heifer according to the old system corresponded to 2/3 "høved", this means that from 1886 to 1922 the number of grazing animals only answered to 40-48 head of large cattle, each having between 1.7 and 2.0 ha.

Compared with earlier times this seems a strong reduction of the grazing stress. During the period from 1886 to 1922, however, the vegetation in the area changed considerately.

The commons were not fertilized and grazing and leaching gradually made the sandy soil so acid and unfertile that heather began spreading. Local people have told that the hills in Borup Gade and Tjørnestykket were red with heather in the close of the 19' century. In the pollen diagram (fig. 3) heather has its maximum in samples no. 6 to 3 dating from the decades around 1900.

During the period of common grazing the farmers were in great need of shrubs not only for fencing, but also for their stoves, baking ovens etc. Therefore, in the 19' century shrubs played an insignificant role in Danish commons as can be seen from paintings of this period. So it is plausible to consider also the commons in question as being almost without shrubs.

In the beginning of the 19' century the area per head of large cattle was 0.8-0.9 ha. This increased considerably through the century up to 1.7-2.0 ha by the time the common grazing stopped in 1922, undoubtedly as an adaptation to the deteriorating

TABLE 1

Period	Haveris Skov Borup Ris	Borup Gade	Hesbjerg Vænge	Bondegårdsmark	Tjørnestykke, north	Tjørnestykke, south	Total area for grazing	Vegetation in the area	Number of "høveder"	Area in ha per "høved"
1758	+	+	+	+	+	+	189.2	Commons Forest	140	1.4
1805	+	+	+	+	+	+	189.2		100	1.9
1808-1874		+	+		+	+	67.2		72-84	0.8-0.9
1874-1888		+	+	+	+	+	103.5		72-84	1.2-1.4
1888-1922			+	+	+	+	81.5		40-48	1.7-2.0
1922-1948				+		+	49.4		?	?
1948-1983						+	13.1		24	0.5
Area in ha	85.7	22.0	16.3	36.3	15.8		189.2			

Table 1. The area of the different lots of Rejnstrup Overdrev used for grazing by the farmers of Rejnstrup and Gunderslevlille from 1758 to 1922 and by the manor of Gunderslevholm from 1922 to 1983, and the number of grazing animals measured as "høveder" (= head of large cattle). 1 "høved" = 1 three-year-old head of cattle = 3/2 two-year-old heifers = 2 one-year-old heifers = 2/3 horse.

fertility of the commons.

In 1922 the manor decided to take over the mangement of the area which meant a radical change of conditions. Hesbjerg Vænge and the northern part of Tjørnestykket were planted. From 1948 Bondegårdsmarken was cultivated. The area for grazing was now reduced to the southern part of Tjørnestykket covering about 13 ha. The lower part of this area was ditched already in the 1920'ies.

It is not known how many heifers and horses from the manor were grazing during the first two decades, but from the 1940'ies the owner of the estate, Rolf de Neergaard, estimates the number at about 35 (corresponding to 24 head of large cattle), i.e. very heavy grazing with only 0.5 ha per "høved".

On the hill at least the vegetation consisted of oligotrophic species like *Calluna vulgaris, Deschampsia flexuosa,* and *Festuca ovina* (cf. table 6) which meant very poor grazing. In the 1940'ies the manor began to manure the area with lime in order to improve the grazing, and after 1945 this was supplemented with fertilizers containing potassium and phosphate. When the area was protected in 1952 and 1968 continued fertilizing was allowed. The method used by the manor to procure better grazing without ploughing has also been used elsewhere in Denmark. Rismøller (1972, page 100) reports that a farmer in Bælum (N-Jutland) made good grazing of some heather-covered hills by manuring with lime and superphosphate and grazing with heifers. The Bælumfarmer furthermore sowed seeds of grass which was not done in Tjørnestykket.

In 1948 the old ditches were replaced by drains. Traces of the ditches and drains are visible in the airphoto from 1954 (fig. 7). By now the drains are clogged up and the depressions are again inundated during the winter.

In 1983 Tjørnestykket was included in the deer park and now red, fallow and sika deer together with some mouflons substitute the cattle on the common.

The present vegetation of Borup Gade and Tjørnestykket

The different development of shrubs in Borup Gade and in Tjørnestykket

BORUP GADE. Since 1888 this lot was part of the deer park and the deer effectively kept the overgrowth in check. In connection with the investigations in Tjørnestykket which will be dealt with later (page 13f.), Dyhre Rasmussen mapped and measured the hawthorns in an about 5 ha large section of Borup Gade including the western part of the hill, Gadebakken, and an area west and east of it. Here he found 63.5 hawthorns per ha, but of an average height of only 0.21 m (varying from 0.05 to 0.50 m). The airphoto from 1954 (part of which is seen in fig. 7) shows the area almost without shrubs. In the part of the air photo not shown in fig. 7 four bigger hawthorns can be seen, among these 2 in the northeastern corner and 1 in Gadebakken. The same 4 can be seen on the airphoto from 1986 (fig. 12). and today they have a high trunk and a crown above the reach of the deer (fig. 4). In addition the area today contains several small (0.2-0.3 m high), strongly bitten thorns (fig. 5).

TJØRNESTYKKET. Until the end of the common grazing in 1922 the farmers' utilization of shrubs for

Fig. 4. Hawthorn on the hill in Borup Gade. August 1986. Mikkelsen phot. The same hawthorn can be seen on fig. 6 and fig. 9. Fig. 14 in Steensberg et al. 1968 shows the same hawthorn in the 1950'ies when it was more upright.

fencing, fire wood etc. together with the grazing undoubtedly kept the common more or less free of shrubs. According to information from other parts of the country (Mikkelsen et al. 1986), because of lack of fodder for the winter the cattle stayed out for a longer period than in this century. In fact the cattle often stayed in the commons until after Christmas and this affected the growth of the shrubs. Very likely relatively heavy grazing between 1922 and the time of fertilization in the 1940'ies kept status quo concerning the shrubs.

The great change took place after the supply of lime and fertilizers together with the drainage in the 1940'ies. The airphoto from 1954 (fig. 7) shows the beginning of the overgrowing. Most of the shrubs and the largest ones are found in four grups: 1. in the northwestern corner, 2. along the western border towards Borup Gade, 3. along the southern border of the western half of the area, and 4. from the western part of 3 towards a denser scrub along the eastern border.

The investigations of Tjørnestykket 1958 and 1986

In connection with the archaeological investigations starting in the beginning of the 1950'ies the whole area was divided in squares of 100 × 100 m (Steensberg et al. 1968, survey map). Each square was further divided into 4 of 50 × 50 m and the corners were marked with concrete blocks.

Inspired by Steensberg the late Dyhre Rasmussen in 1958 measured and mapped (scale 1:250) all groups of shrubs in Tjørnestykket. His notes still exist, but some of his maps are missing.

Fig. 6 is drawn from his maps. Dyhre, originally

a smith, was an able archaeologist but did not know all the species of shrubs. In 1986 it was possible to identify several of the species unknown to him, e.g. *Euonymus europaeus*, *Rhamnus cathartica*, and *Ribes rubrum*. Unfortunately his maps had not been found when the investigation took place in the late spring of 1986 and therefore table 2 still contains not identified species in 13 groups of shrubs. Most probably these species are for the most part the same species already listed in the table.

In 1986 Steensberg and Mikkelsen repeated Dyhre's investigations in a 50 m wide belt (the squares in +5 east) stretching from north to south through Tjørnestykket (fig. 7, 10a and b) in order to measure the changes since 1958. These are further elucidated by airphotos from 1974 (fig. 8) and 1986 (fig. 11).

Table 2 gives a survey of Dyhres investigation in 1958 as well as of the recent one in 1986.

The shrubs in Tjørnestykket in 1958

The first column in table 2 shows Dyhre's results for the whole area, while the second gives his results for the squares in +5 east. A comparison between them shows the frequencies of the species and the average height of the groups (2.0 m and 1.8 m) to be almost identical. Hence, the squares in +5 east can with rather good probability be regarded representative of the area.

Dyhre measured the height of 963 groups to an averge of 2.0 m. There is some variation. The tallest groups are situated in the southwestern corner of the common and in the middle of the eastern part. Also several large oaks are found here close to the roads south and east of the common.

The smallest number of groups and the lowest

Fig. 5. Hawthorn in Borup Gade, bitten down to the height of the grass. Mikkelsen phot. 1986.

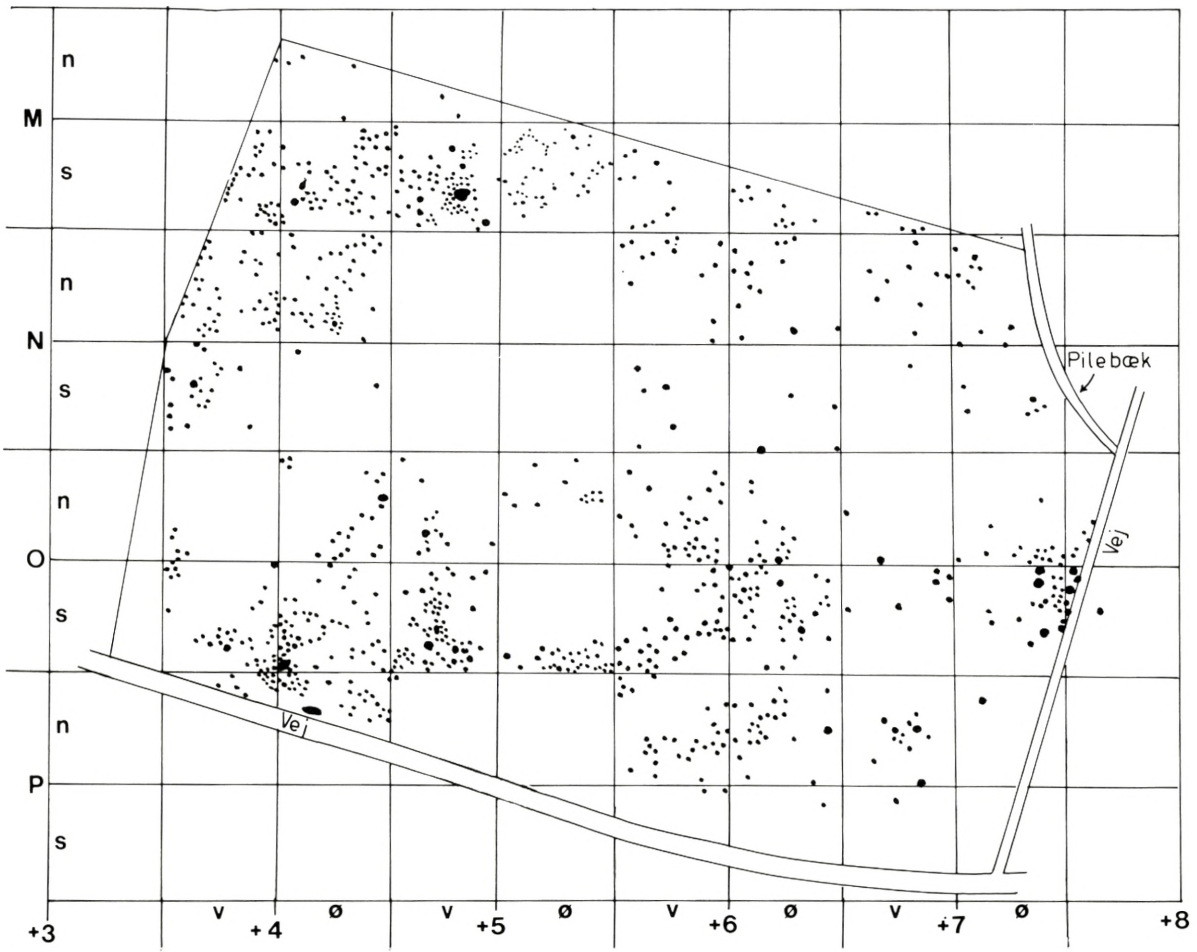


Fig. 6. Map showing the distribution of groups of hawthorn in Tjørnestykket in 1958. Drawn by K. Svendsen after the original maps of S. Dyhre Rasmussen. The original maps of +5 N and +5 P are missing.

average height were found on the hill and in the low areas southwest of the hill (cf. airphoto fig. 7).

The weaker overgrowth of higher as well as lower localities may be caused by the soil humidity the higher ones being too dry, the lower too wet.

10 of the 15 species listed in table 2 have fleshy fruits and the fruits of 2 others (*Corylus and Quercus)* are also edible. These species are dispersed by birds and other animals, and this must be how they invaded the common. The last 3 species (*Betula, Fraxinus* and *Ulmus*) have winged fruits and are dispersed by the wind.

The most common species (*Crataegus spp. Prunus spinosa*, and *Rosa spp.*) have spines protecting them against the grazing animals, the same applies to *Malus sylvatica, Ribes uva-crispa,* and *Rhamnus cathartica.* The bark of *Sambucus nigra* contains poisonous and foul elements and elder is usually avoided by grazing animals. This is also the case with *Euonymus europaeus*..

In 1958 Dyhre found the following numbers of rather large trees: 9 *Quercus robur,* 2 *Fraxinus exelsior,* 1 *Ulmus glabra,* a group of 3 *Betula pendula,* and 1 *Sorbus aucuparia* together with 1 *Corylus avellana.* The

TABLE 2

	1958				1986	
	1		2		3	
	All sq.		Sq. in +5ea.		Sq. in +5ea.	
	n	%	n	%	n	%
Betula pendula	1	0.1	–	–	–	–
Corylus avellana	1	0.1	–	–	–	–
Crataegus spp.	874	90.8	138	95.8	133	89.9
Euonymus europaeus	2	0.2	–	–	1	0.7
Fraxinus excelsior	2	0.2	–	–	–	–
Malus sylvatica	7	0.7	–	–	1	0.7
Prunus spinosa	82	8.5	6	4.2	18	12.2
Quercus robur	9	0.9	–	–	–	–
Ribes rubrum	2	0.2	–	–	1	0.7
Ribes uva-crispa	–	–	–	–	5	3.4
Rhamnus cathartica	2	0.2	1	0.7	1	0.7
Rosa spp.	263	27.3	32	22.2	85	57.4
Sambucus nigra	27	2.8	3	2.0	91	61.5
Sorbus aucuparia	2	0.2	1	0.7	1	0.7
Ulmus glabra	1	0.1	–	–	–	–
Unknown	13	13.4	–	–	–	–
Total of groups	963		144		148	
Average height	2.0		1.8		4.9	

Table 2. The groups of shrubs in Tjørnestykket 1958 and 1986. Column 1 shows the total and percentage occurrence in all 963 groups. Column 2 and 3 give the corresponding values in the six squares in +5 east in 1958 and 1986, respectively.

first four species are still growing in the area, while *Sorbus aucuparia* (close to the highway south of the common) died in 1986 and *Corylus* is not found at all in 1986.

All these species of trees have good possibilities of dispersal, and even when young shoots are eaten by cattle most of them are able to survive as strongly bitten individuals for many years and become trees when protected against the grazing cattle, e.g. by spiny shrubs.

It is remarkable that so few of these trees have been able to establish themselves on Tjørnestykket during the period until 1958 and that from 1958 to 1986 no single individual has grown up in the squares of +5 east.

Birch germinates only on open land and here the young plants are eaten by cattle. The other species are also light demanding, but at least oak will often germinate in a scrub of spiny shrubs protecting its young plants. Hence the establishment of oak in Tjørnestykket could be expected to be favoured, like oak and hazel in the commons of Rejnstrup in Medieval times (cf. page 9). The reason for this diverging development in recent time must be the heavy cattle grazing and the ensuing special structure of the shrubs. The sloes in the area are very strongly bitten and were so also in 1958. In other places an unbroken ring of sloes around a group of shrubs often provides a good bed for young trees. In Tjørnestykket, however, such continuous rings usually are missing. Mostly there is one or more passages through the sloes and so the cattle can reach the young trees which may have germinated there (cf. fig. 9).

Another important cause for the difference between Medieval and recent overgrowing is the absence of pigs from the modern common.

The growth of the shrubs from 1958 to 1986

The present investigation took place in 1986, but should really have been conducted in 1983 when Tjørnestykket was included in the deer park. Since 1966 mostly fallow deer but also some red deer have inhabited the park. The shrubs in Tjørnestykket are already influenced by them, especially their rubbing of antlers has broken many more or less dead stems of roses in the outskirts of the scrubs.

In 1986 all groups of shrubs in the squares of +5 east were measured and mapped (scale 1:400). Figs. 10a and b show the results.

The overgrowth is further illustrated by airphotos. The first from 1954 (fig. 7) shows the area before Dyhre's investigations, the second from 1974 (fig. 8) an intermediate phase in the process. Fig. 11 shows Tjørnestykket in 1986.

A comparison of the airphotos shows that the groups of shrubs have increased in size, and in the areas with the largest shrubs in 1958 the crowns are overlapping already in 1974. In the 1974 photo it is also possible to recognize more groups than in the photo from 1954. However, many groups were in 1958 lower than 1 m and would not have been visible in the photo taken 4 years before. In the photos from 1974 and 1986 it is possible to recognize all the groups mapped in the four northern squares. The tallest of them can also be found on the photo from 1954. In the two southern squares the crowns were so overlapping already in 1974 that only few of the groups mapped in 1986 can be identified.

The considerable increase of crowns in the whole area can be seen when comparing the photo from 1954 with the maps (figs. 10a and b) and the photo from 1986 (fig. 11).

While the crowns of the groups have increased considerably from 1954 to 1986, the number of groups has not changed significantly. In 1958 Dyhre mapped 144 groups in the squares of +5 east, while the map of 1986 contains 148. The difference has several causes. In the northern squares it is possible to compare the individual groups as mapped in 1958 and in 1986. Such a comparison shows that in a few cases a group at one time was considered a single and the other time 2 separate groups. One group consisting in 1958 of a single, dying hawthorn was missing in 1986. Very few new groups were found in 1986 and then consisted of small shrubs of sloe or hawthorn close to similar groups mapped both years.

On the other hand the height of the groups has similarly to the crowns, increased markedly. In the individual squares of +5 east the average height has increased from 1.1-2.2 m in 1958 to 4.1-5.4 m in 1986. The average height for all squares has increased from 1.8 to 4.9 m, i.e. about 3 m in 28 years.

A comparison between column 2 and 3 of table 2 shows that also the composition of species has changed during these years. The number of groups with hawthorn is almost unchanged, namely 138 and 133 groups in 1958 and 1986, respectively. The occurrence of *Sambucus nigra* and *Rosa spp.* has on the other hand increased markedly. In 1958 elder was found in only 3 groups, but in 1986 in 91 groups. The number of groups with rose increased from 32 to 85. Sloe was in 1958 found in 6 groups, and in 1986 in 18.

Rhamnus cathartica and *Sorbus aucuparia* were found in just one group both years, but in 1986 the rowan died.

New species in +5 east in 1986 are a big *Malus* (possibly overlooked by Dyhre in 1958) and small individuals of *Euonymus, Ribes rubrum,* and *R. uva-crispa,* all found in only one or a few groups.

It is difficult to form a prognosis of the development which started when the common became part of the deer park. Recent observations, however, indicate that at least the taller hawthorns eventually will become highstemmed with their crown beyond the reach of the deer.

Fig. 7. Airphoto of Tjørnestykket from 1954. The 50 × 50 m squares in +5 east are marked in the photo. Part of the surrounding area is described in the text to fig. 12. The eastern part of Tjørnestykket, east of the N-S-running road and north of the brook Pilebækken (the black line), was still open land. Geodætisk Institut phot.

The vegetation of herbs and grasses

At the close of the 19' century pastures covered more than 100 ha in Rejnstrup Overdrev. In present time it is reduced to about 35 ha, i.e. 22.0 ha in Borup Gade and 13.1 ha in the sourthern part of Tjørnestykket.

As mentioned above, from 1808 both lots were used for common grazing by the farms belonging to the manor Gunderslevholm. The sandy soil and the exploitation were uniform in the two lots and so was undoubtedly the vegetation as long as the common grazing lasted. In Borup Gade the cattle grazing stopped in 1888 when the area became part of the deer park, while in Tjørnestykket it lasted until 1922.

Just as the two lots differ in the vegetation of shrubs, so the vegetation of grasses and herbs is very different in the two areas in present time.

The main cause of these differences undoubtedly is that Tjørnestykket in contrast to Borup Gade has been limed and fertilized since the 1940'ies.

In Mikkelsen 1986, table V, are given some values for pH but these must be considered uncertain as they were made with very primitive instruments.

Fig. 8. Airphoto of Tjørnestykket from 1974. The 50 × 50 m squares in +5 east are marked in the photo. Concerning surrounding area, see text to fig. 12. The part east of the road is now covered with a plantation. Landinspektørernes luftfotoopmåling phot.

In the 1970'ies, however, some analyses of pH and the content of P were made in the western part of Borup Gade near the lots of the ancient farms (Steensberg 1983a, page 81). On the western part of the hill were found pH 4.7 and 1.2-2.8 mg P_2O_5 per 100 g soil (corresponding to 5 to 12 ppm P). These values are similar to those found in 1986 (table 3), so no major changes seem to have taken place in Borup Gade.

On the other hand table 3 shows that the contents of some important nutrientes are now much higher in the soil in Tjørnestykket than in Borup Gade. The average value of pH is 5.3 in Tjørnestykket versus 4.3 in Borup Gade, and the contents of Ca and P are 3 to 4 timers higher in Tjørnestykket.

There are no analyses of the herbaceous vegetation of Borup Gade from earlier times. As will be shown below, the analyses reported in Mikkelsen 1986 were made in Tjørnestykket, not in Borup Gade. In Tjørnestykket a few Raunkiær-analyses were made in 1919 (Gröntved 1927) and in 1941 (Mikkelsen 1986). These analyses describe the vegetation prior to the liming and fertilization of the area and will be compared with the analyses made in 1986.

Fig. 9. Groups of shrubs (hawthorn, rose, elder and sloe) in Tjørnestykket. Mikkelsen phot. 1986.

The investigations of Johs. Gröntved in 1919

In his paper on Danish commons (1927), Johs. Gröntved refers to two analyses of the vegetation in Knurrevang south of Lake Tystrup-Bavelse. The name Knurrevang has been used as a joint name for i.a. Borup Gade and Tjørnestykket. In 1919 Borup Gade as deer park was provided with a high fence and most probably the analyses were made in the southern part of Tjørnestykket which was far more accessible from the road.

Gröntved's localitity no. 28 is a depression with peaty soil. Some of the species found here are listed in column 1919A, table 6. Of the species mentioned by Gröntved the following were dominant (i.e. frequency ≥ 80): *Potentilla erecta, Sieglingia decumbens, Festuca rubra, Ranunculus acris, Trifolium repens, Carex panicea,* and *Prunella vulgaris*. With a frequency ≥ 50 were found: *Anthoxanthum odoratum, Briza media, Cirsium palustre, Festuca ovina, Juncus compressus,* and *J. articulatus*. The community was very rich in species, the paper (op.cit. page 11) mentioning 53 species.

Gröntved's locality no. 9 represents the vegetation on tufts in a low-lying flat. In column 1919B, table 6, are listed some of the in all 37 species found in this locality. Dominant are *Achillea millefolium, Agrostis tenuis, Festuca ovina,* and *Hieracium pilosella*. A frequency of 50 or more had *Aira praecox, Campanula rotundifolia, Carex caryophyllea, Luzula campestris, Potentilla erecta, Sieglingia decumbens,* and *Thymus pulegioides*.

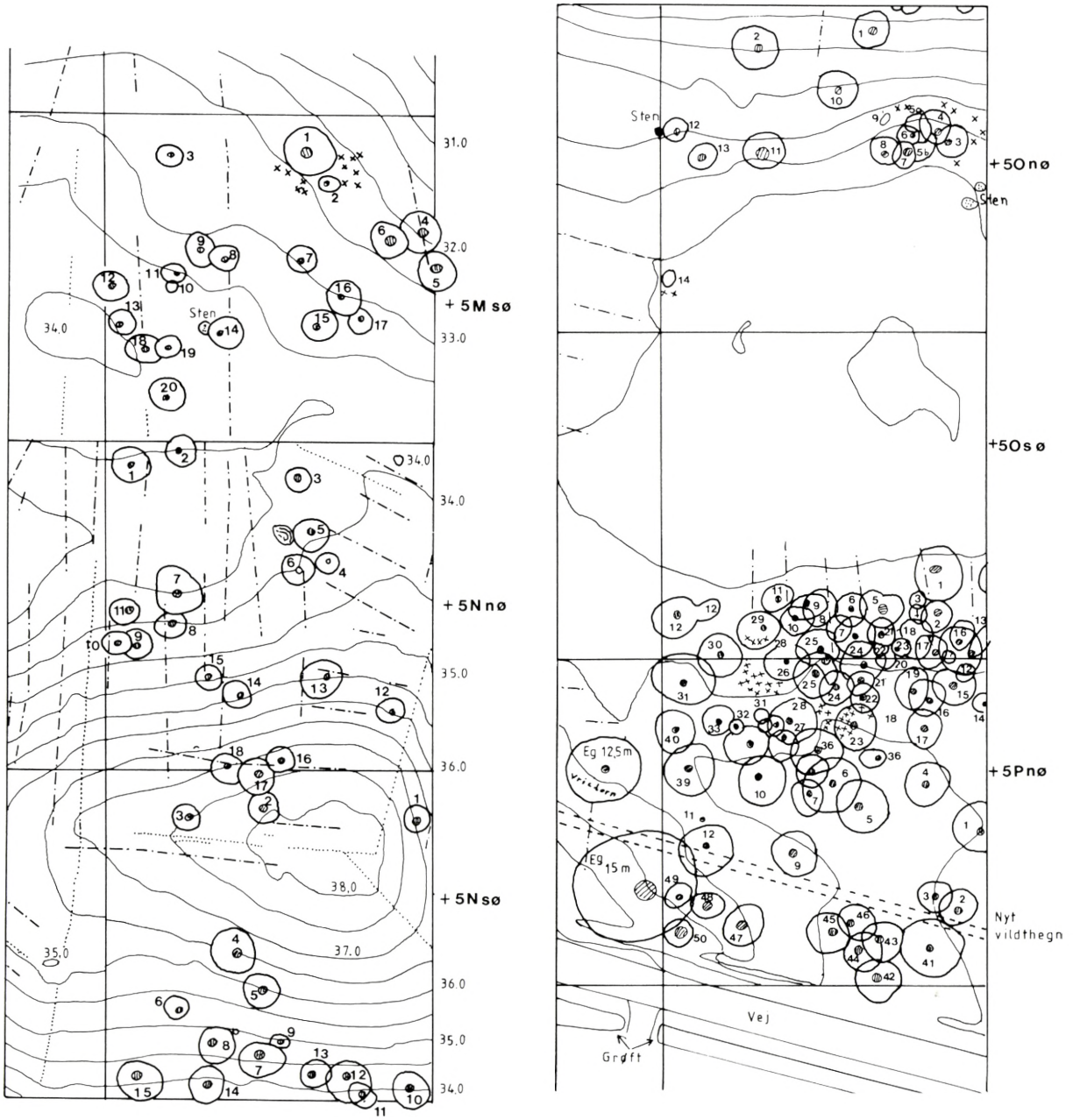


Fig. 10a and b. Map showing the groups of shrubs in a 50 m broad section (+5 east) from N to S through Tjørnestykket in 1986. For each group the extension of trunk and crown is noted. The groups are numbered consecutively within each of the 6 squares. x signifies *Prunus spinosa* outside the groups. Mapped and measured by Steensberg and Mikkelsen, drawn by K. Svendsen.

Fig. 11. Airphoto of Tjørnestykket. Autumn 1986. Jan Kofod Winther phot.

Excursion with Knud Jessen 1941

As a student, in 1941, the author participated in an excursion guided by professor Knud Jessen, and we made Raunkiær-analyses on the hill in Knurrevang. In Mikkelsen (1986) I assumed this locality to be the hill in Borup Gade which in the 1950'ies had a vegetation corresponding to these analyses in contrast to the hill in Tjørnestykket. However, since then a map of the area has been found in which Knud Jessen marked the locality on the hill in Tjørnestykket.

A selection of the species found on top of the hill are listed in column 1941D, table 6, and the following species are dominant in the community: *Achillea millefolium, Agrostis tenuis, Carex pilulifera, Festuca ovina, Hieracium pilosella, Luzula campestris, Polygala vulgaris, Sieglingia decumbens, Thymus pulegioides,* and *Viola canina.* With a frequency of 50 or more were found: *Campanula rotundifolia, Lotus corniculatus, Plantago lanceolata,* and *Ranunculus bulbosus.*

Analysis 1941E, table 6, represents the vegetation on the south slope of the hill. Dominant are: *Calluna vulgaris, Carex pilulifera, Deschampsia flexuosa, Festuca ovina,* and *Galium saxatile.* A frequency ≥ 50 had *Hieracium pilosella, Potentilla erecta,* and *Trifolium medium*

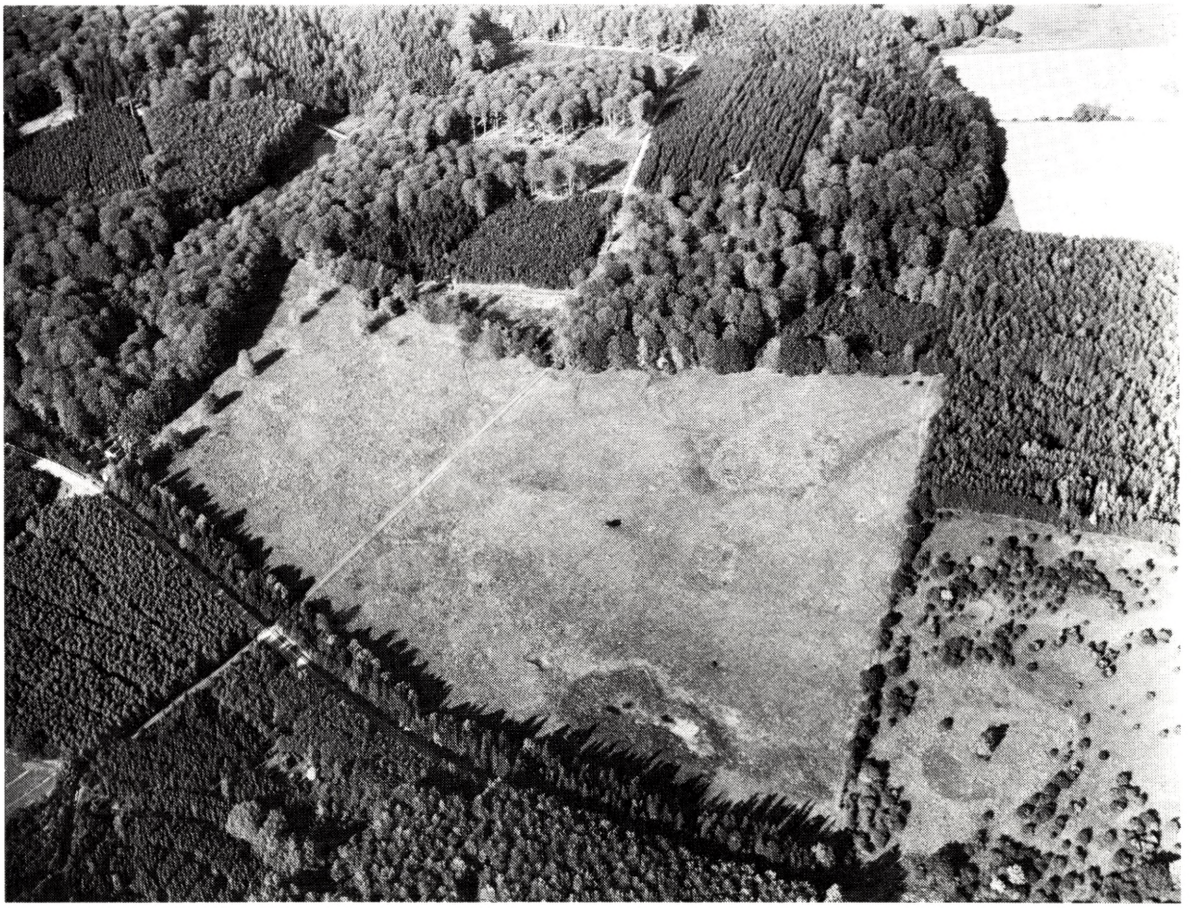


Fig. 12. Airphoto of Borup Gade. Autumn 1986. In the south-eastern corner Tyste mose, just north of which the hawthorn on the hill shown in fig. 4 can be seen as a black dot. 2 other hawthorns are situated in the northeastern corner and 1 in the middle of the area. West and north of Borup Gade is Haveris Skov and Borup Ris and south of the road is the plantation in Hesbjerg Vænge. The eastern part of the photo shows from north to south: the cultivated fields of Bondegårdsmarken, the plantation in the northern part of Tjørnestykket, and the common in its southern part. Jan Kofod Winther phot.

The vegetation of Tjørnestykket in 1986

Along a straight, 300 m long line running from north to south in the middle of +5 east, Raunkiær-analyses were made for each m (cf. fig. 13). In the dense thicket of hawthorns (community F, fig. 13), however, only 10 analyses were made.

Roughly the vegetation can be divided into 7 different communities: A: depressions, in winter more or less inundated, B: flats at a slightly higher level, C: the north slope of the hill, D: the somewhat drier top of the hill, E: the south slope, and F: the ground vegetation in the thicket of thorns, usually dominated by *Urtica dioeca*

In table 4 are listed the species of these communities. The communities A-E are dominated mainly by grasses, and *Agrostis tenuis* is a dominant in all of them, while *Carex hirta, Festuca rubra, Lolium perenne, Poa pratensis,* and *Ranunculus acris* each dominates in one or more communities. Further comments on the vegetation are given below.

TABLE 3

		Tjørnestykket							Borup Gade				
		A	B	C	D	E	F	m̄	B	C	D	E	m̄
pH	0-10 cm	5.4	5.4	4.4	5.0	5.7	4.9	5.2	–	4.3	–	4.2	4.3
	10-20 cm	5.5	5.2	4.7	4.8	5.6	5.4	5.1	–	4.3	–	4.4	4.3
lt	0-10 cm	197	163	97	198	130	146	168	–	125	–	120	123
	10-20 cm	141	121	65	112	106	136	121	–	73	–	63	66
Ca	0-10 cm	11.7	7.1	2.9	6.7	8.9	10.8	7.4	–	1.7	–	1.7	1.7
	10-20 cm	9.9	6.1	2.8	3.7	7.0	11.7	7.6	–	1.1	–	1.0	1.0
Mg	0-10 cm	2.0	1.4	0.5	1.2	1.1	1.0	1.4	–	0.8	–	0.8	0.8
	10-20 cm	1.4	0.8	0.3	0.5	0.7	1.0	0.9	–	0.4	–	0.4	0.4
K	0-10 cm	0.2	0.6	0.2	0.4	0.2	0.3	0.3	–	0.2	–	0.2	0.2
	10-20 cm	0.1	0.2	0.1	0.2	0.1	0.2	0.1	–	0.2	–	0.1	0.1
Na	0-10 cm	0.7	0.5	0.4	0.5	0.4	0.5	0.5	–	0.4	–	0.4	0.4
	10-20 cm	0.4	0.6	0.4	0.4	0.4	0.5	0.5	–	0.4	–	0.4	0.4
Mn	0-10 cm	1.1	2.8	0.5	1.1	1.0	0.4	1.3	–	3.8	–	1.5	2.8
	10-20 cm	0.5	1.2	0.3	0.3	0.2	0.3	0.5	–	1.6	–	0.5	1.0
P	0-10 cm	35	26	25	42	33	29	35	–	10	–	11	10
	10-20 cm	27	19	13	26	30	22	24	–	9	–	8	8
n		3	1	1	1	1	1	8		2		2	4

Table 3. Analyses of soil samples in Tjørnestykket (April 1986) and Borup Gade (June 1986): Ca, Mg, K, Na and Mn in meq/100 g soil. P in ppm. Conductivity (l_t) in μ mho.

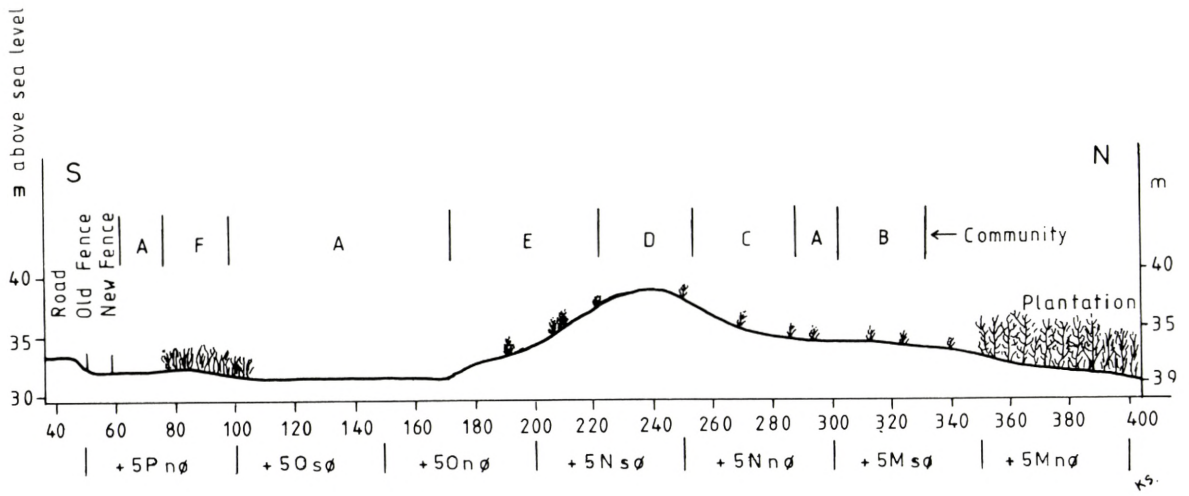


Fig. 13. N-S transect through the middle of the row of squares in +5 east, showing the placing of different plant communities. A: depressions, B: flats, C: north slope, D: top of hill, E: south slope, F: thickets of thorns. Measured in 1986 by V. and G. Mikkelsen, drawn by K. Svendsen.

The vegetation of the hill in Borup gade in 1986

Along a 100 m long line along the eastern border of the squares +2N north and +2M south (fig. 14) Raunkiær-analyses were made for each m. The vegetation is made up of 4 communities: B: the flat area north of the hill, C: the north slope, D: the top of the hill, and E: the south slope, a division analogous with that of Tjørnestykket.

Table 5 shows the frequencies of the species in these 4 communities. Like in Tjørnestykket all communities have *Agrostis tenuis* as a dominant, while each of the species *Achillea millefolium*, *Carex hirta*, *Poa pratensis*, and *Stellaria graminea* dominates in one or more communities.

Table 6 shows that several of the species found in the older analyses but now missing or sparse in Tjørnestykket still occur relatively frequently in Borup Gade in 1986. These species are: *Campanula rotundifolia*, *Carex caryophyllea*, *C. pilulifera*, *Deschampsia flexuosa*, *Festuca ovina*, *Galium saxatile*, *Hieracium pilosella*, *Luzula campestris*, *Potentilla erecta*, *Sieglingia decumbens*, and *Veronica officinalis*. In addition *Viola canina* is found on the south slope and *Calluna vulgaris* and *Thymus pulegioides* occur on some of the anthills.

While the anthills in Tjørnestykket usually are more or less eroded, those in Borup Gade are mostly more well-preserved and very often inhabited. Undoubtedly the many *Calluna* seedlings on the anthills are the result of the ants' bringing old seeds to the surface.

Deschampsia cespitosa occurs sparsely in the flat area north of the hill and on the north slope. While this species characterizes the depressions in Tjørnestykket, *Molinia coerulea* plays the same role in the not analysed depressions in Borup Gade.

Antennaria dioeca, *Cirsium acaule*, and *Polygala vulgaris* are not listed in the analyses, but they are all still present in unanalysed parts of Borup Gade.

Fig. 14. N-S transect through the hill in Borup Gade along the border between the squares +2 and +3, from the concrete block at the border between M south and M north to the block at the border between N north and N south. Plant communities as in fig. 13. Measured in 1986 by V. and G. Mikkelsen, drawn by K. Svendsen.

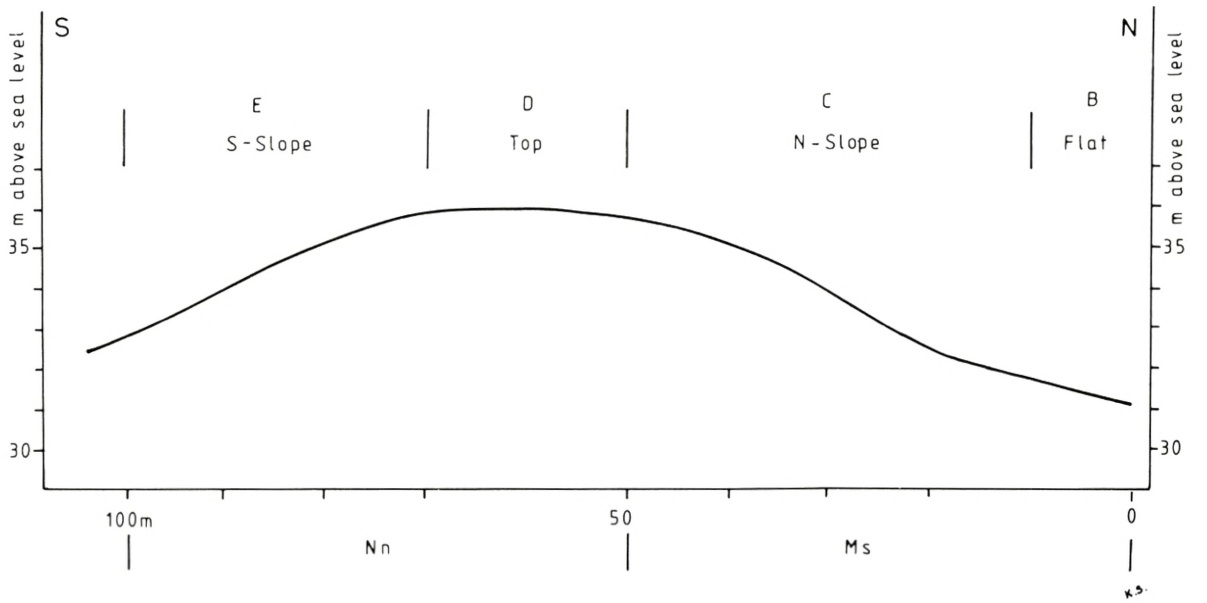


TABLE 4

Tjørnestykket 1986	A	B	C	D	E	F
	Depr.	Flats	N-sl.	Top	S-sl.	Scrub
Number of sample plots	68	30	34	29	45	10
Achillea millefolium	10	30	21	28	22	–
Agrostis stolonifera	1	–	–	–	–	–
Agrostis tenuis	87	83	100	97	96	60
Alopecurus geniculatus	3	–	–	–	–	–
Anemone nemorosa	–	–	–	–	–	30
Anthoxanthum odoratum	+	3	15	–	–	10
Bromus mollis	–	–	–	–	18	–
Campanula rotundifolia	–	–	–	–	9	–
Cardamine pratensis	4	–	–	–	–	–
Carex hirta	60	97	56	62	82	–
Capsella bursa-pastoris	10	3	–	–	27	–
Cerastium fontanum	38	10	15	14	33	10
Cirsium arvense	3	–	–	–	4	–
Cirsium palustre	1	3	–	–	4	–
Cynosurus cristatus	4	–	3	3	16	–
Dactylis glomerata	3	–	3	+	+	–
Deschampsia cespitosa	28	10	32	–	2	–
Festuca ovina	–	–	–	3	2	–
Festuca pratensis	63	17	12	–	–	10
Festuca rubra	66	100	82	93	62	30
Galium verum	–	–	–	–	2	–
Galium aparine	–	–	–	–	–	10
Holcus lanatus	16	–	18	–	–	–
Hypericum maculatum	–	–	3	–	–	–
Juncus compressus	+	–	–	–	–	–
Juncus effusus	1	–	–	–	–	–
Leontodon autumnale	7	+	15	21	29	–
Lolium perenne	32	23	53	93	80	20
Lotus corniculatus	–	–	6	–	–	–
Luzula campestris	–	+	3	–	–	–
Medicago lupulina	1	–	–	–	2	–
Moehringia trinervia	–	–	–	–	–	30
Phleum pratensis	12	–	3	–	2	–
Plantago lanceolata	1	3	24	24	22	–
Plantago major	4	–	–	–	–	–
Poa pratensis	72	97	97	83	87	60
Polygonum aviculare	6	+	–	–	4	10
Potentilla anserina	7	–	–	–	–	–
Potentilla erecta	1	–	–	–	–	–
Ranunculus acris	84	23	76	3	22	40

TABLE 4, continued

Tjørnestykket 1986	A	B	C	D	E	F
	Depr.	Flats	N-sl.	Top	S-sl.	Scrub
Number of sample plots	68	30	34	29	45	10
Ranunculus bulbosus	–	–	–	–	2	–
Ranunculus flammula	3	–	–	–	–	–
Ranunculus repens	24	–	–	–	7	20
Rumex acetosa	9	27	32	3	1	10
Rumex acetosella	–	–	–	21	–	–
Stellaria media	–	–	9	7	11	60
Stellaria graminea	28	50	74	34	51	–
Taraxacum spp.	12	–	–	–	13	10
Thymus pulegioides	–	–	–	–	2	–
Trifolium repens	31	–	65	24	36	10
Torilis japonica	1	–	–	3	–	20
Urtica dioeca	7	–	–	14	2	90
Veronica chamaedrys	4	–	12	10	2	20
Veronica officinalis	–	–	–	–	2	–
Veronica serpyllifolia	3	–	–	–	2	–
Number of species	44	20	26	22	36	23

Table 4. Raunkiær-analyses from Tjørnestykket 1986. Apart from the species listed, also the following were present: in A. *Carex distica, C. leporina, Vicia cracca,* and *Glyceria sp.;* in B: *Vicia cracca,* in C: *Nardus stricta,* in D and E: *Trifolium minus*; in F: *Alliaria officinalis, Epilobium montanum,* and *Poa nemoralis.*

Changing ecological factors and their influence on the vegetation

Changes in the frequencies of the species in the two areas must be caused by changes in the ecological conditions. Change of a given factor may enhance the competitive power of some species and increase their frequency, while the effect of other changes may be quite different.

In Tjørnestykket the liming and fertilization commenced in the 1940'ies has changed the edaphic conditions from an acid soil, poor in Ca to a less acid soil with much more Ca. As mentioned above, such changes have not taken place in Borup Gade. Hence this factor can be responsible for changes in species frequency in Tjørnestykket, not in Borup Gade.

Since the 1950'ies another edaphic factor has changed in both areas, namely the humidity of the soil. In the 1950'ies Tyste Mose in Borup Gade was investigated and it was then possible to work in ditches more than 1 m deep without having difficulties with the ground water. Today there is a free water table in the bog even in the summer. The increased wetness of today must be caused by the clogging up of the drains made in 1948 and still functioning in the 1950'ies. This change common to the two areas has directly changed the vegetation of the bog from 1953 to 1986, but no analyses have been made.

The more humid conditions have undoubtedly caused better growth for the grasses at least in the lower areas and thus more food for the grazing animals which no longer can keep the vegetation so closely cropped as it was in the 1950'ies.

TABLE 5

Borup Gade 1986	B Flats	C N-sl.	D Top	E S-sl.
Number of sample plots	10	40	20	31
Achillea millefolium	90	48	85	71
Agrostis tenuis	90	90	95	97
Anthoxanthum odoratum	20	20	10	42
Calluna vulgaris	–	–	–	16
Campanula rotundifolia	50	58	50	77
Carex caryophyllea	–	3	30	19
Carex hirta	100	38	45	19
Carex pilulifera	10	25	–	58
Cerastium fontanum	10	5	5	3
Deschampsia cespitosa	+	3	–	–
Deschampsia flexuosa	20	48	60	29
Festuca ovina	20	50	30	61
Festuca rubra	40	5	10	–
Galium verum	–	3	–	6
Galium saxatile	–	33	35	42
Hieracium pilosella	10	8	15	26
Hypericum maculatum	–	–	–	6
Hypochoeris radicata	–	–	–	6
Lotus corniculatus	–	3	–	–
Luzula campestris	10	45	15	58
Nardus stricta	–	10	5	3
Plantago lanceolata	–	3	5	35
Poa pratensis	100	65	80	6
Potentilla erecta	40	18	5	6
Ranunculus acris	10	8	–	–
Rumex acetosa	–	8	–	–
Rumex acetosella	–	8	55	42
Sieglingia decumbens	–	–	15	34
Stellaria media	–	–	10	3
Stellaria graminea	80	8	55	32
Thymus pulegioides	–	+	–	3
Veronica chamaedrys	20	18	–	–
Veronica officinalis	–	+	–	23
Veronica serpyllifolia	–	–	–	3
Viola canina	–	–	–	16
Bryophytes	18	13	20	23
Lichens	–	–	–	3
Number of species	18	28	21	29

Table 5. Raunkiær-analyses from Borup Gade 1986.

This factor obviously has influenced the relative competitive power of several species, and as the change is common to both areas its effect in them must be similar.

A more specific ecological factor is the red deer which in contrast to the fallow deer has a special partiality for *Calluna vulgaris* and *Urtica dioeca*. In Borup Gade the red deer was not present between 1910 and 1966, when it was reintroduced. In Tjørnestykket the red deer came with its incorporation into the deer park in 1983.

The changes in the ground vegetation from about 1940 to 1986 and their ecological causes

Gröntved's analyses from 1919 date from the period when Tjørnestykket was part of the area grazed in common by the 12 farms in Rejnstrup and Gunderslevlille.

The analyses from 1941 belong to the period when Tjørnestykket was grazed by heifers and horses from the manor, undoubtedly before the liming and fertilization of the area.

According to local people, the hills in Tjørnestykket and Borup Gade were coloured red with heather in the beginning of the 20' century, and this is confirmed by the pollendiagram. This seems to indicate a similar ground vegetation in the two areas. Therefore it seems acceptable to assume that in broad outline the analyses from 1919 and 1941 represent the vegetation of both areas until 1941 in A: depressions, B: flats, D: tops of the hills, and E: south slopes.

Table 6 lists the frequencies of some characteristic species in the different communities, first the analyses from 1919 and 1941, then Tjørnestykket 1986 and Borup Gade 1986.

The 29 species mentioned can rather easily be divided in 5 groups (table 6).

The 1st group includes 7 species frequent in the old analyses. Among the species *Calluna vulgaris, Polygala vulgaris, Thymus pulegioides,* and *Viola canina* each was a dominant in one community in the analyses from 1919 and 1941. In 1986 all 7 species

TABLE 6

	Tjørnestykket									Borup Gade			
	1919		1941		1986					1986			
	A	B	D	E	A	B	C	D	E	B	C	D	E
Number of sample plots	25	25	10	10	68	30	34	29	45	10	40	20	31
1a Antennaria dioeca	–	–	40	20	–	–	–	–	–	–	–	–	–
Calluna vulgaris	+	–	+	100	–	–	–	–	–	–	–	–	16
Viola canina	8	48	100	20	–	–	–	–	–	–	–	–	16
1b Cirsium acaule	+	12	+	+	–	–	–	–	–	–	–	–	–
Polygala vulgaris	16	32	80	+	–	–	–	–	–	–	–	–	–
Ranunculus bulbosus	+	20	70	–	–	–	–	–	2	–	–	–	–
Thymus pulegioides	+	72	100	10	–	–	–	–	2	–	+	–	3
2a Carex pilulifera	–	20	100	100	–	–	–	–	–	10	25	–	58
Deschampsia flexuosa	–	–	–	100	–	–	–	–	–	20	48	60	29
Festuca ovina	72	100	100	100	–	–	–	3	2	20	50	30	61
Galium saxatile	4	24	40	80	–	–	–	–	–	–	33	35	42
Potentilla erecta	84	56	10	60	1	–	–	–	–	40	18	5	6
Sieglingia decumbens	84	72	80	30	–	–	–	–	–	–	–	15	39
Veronica officinalis	+	48	–	1	–	–	–	–	2	–	+	–	23
2b Campanula rotundifolia	+	76	70	20	–	–	–	–	9	50	58	50	77
Carex caryophyllea	–	72	+	+	–	–	–	–	–	–	3	30	19
Hieracium pilosella	4	100	100	50	–	–	–	–	–	10	8	15	26
Luzula campestris	40	72	100	20	–	–	3	–	–	10	45	15	58
3 Cirsium arvense	–	–	–	–	3	–	–	–	4	–	–	–	–
Deschampsia cespitosa	–	–	–	–	28	10	32	–	2	+	3	–	–
Festuca pratensis	16	–	–	–	63	17	12	–	–	–	–	–	–
Lolium perenne	–	–	–	–	32	23	53	93	80	–	–	–	–
Urtica dioeca	–	–	–	–	7	–	–	14	2	–	–	–	–
4 Carex hirta	16	4	20	+	60	97	56	62	82	100	38	45	19
Poa pratensis	20	–	10	20	72	97	97	83	87	100	65	80	6
Stellaria graminea	4	32	–	–	28	50	74	34	51	80	8	55	32
5 Achillea millefolium	28	80	80	–	10	30	21	28	22	90	48	85	71
Agrostis tenuis	28	88	90	–	87	83	100	97	96	90	90	95	92
Festuca rubra	88	24	–	–	66	100	82	93	62	40	5	10	–

Table 6. Frequencies (according to Raunkiær) of selected species in Tjørnestykket 1919, 1941, and 1986 and in Borup Gade 1986. A: depression, B: flat, C: north slope, D: top of hill and E: south slope. As to the division in groups see the text page 28f. *Carex caryophyllea* was present in 1941, possibly with higher frequencies. My own notes are not quite clear on this point, but contemporaneous notes by a fellow student, dr. Tyge Christensen, verify the presence of this species.

were either missing or very sparse in both areas. As regards the ecology, the 7 species fall into two subgroups 1a and 1b.

The species of 1a: *Antennaria dioeca, Calluna vulgaris,* and *Viola canina* usually grow on rather acid soil (cf. Hansen and Jensen 1974 and Hansen 1976). Hence their decrease in Tjørnestykket could be explained by the liming of this area. Especially the value of 7.4 meq Ca per 100 g soil in Tjørnestykket (table 3) is much higher than the average values of 1.6 to 2.0 for *Calluna* and *Viola* as reported in the papers cited. Concerning the other edaphic factors (pH, l_t, Mg, K, Na, and P), the average values in Tjørnestykket are similar to the average values given by Hansen and Jensen. As the 3 species have decreased also in Borup Gade where the soil is still acid and the other edaphic factors have values similar to the average values of Hansen and Jensen, liming has not been the only cause of their decrease.

The decrease of *Calluna* in Tjørnestykket undoubtedly is due to the liming, while its decrease in Borup Gade may be caused by the red deer. In the 1950'ies *Calluna* was still rather frequent on the hill in Borup Gade, but after the introduction of the red deer in 1966 its decrease accelerated, and today *Calluna* is very sparse and mostly bitten down to a height of few cm.

The decrease of *Antennaria dioeca* and *Viola canina* in Tjørnestykket may be influenced by the liming, but their general decrease in both areas undoubtedly is due to a decrease in competitive power due to the reduced grazing stress. In the areas investigated this again may be the result of the increased humidity in the last decades giving better growth to the food plants.

The species in subgroup 1b: *Circium acaule, Polygala vulgaris, Ranunculus bulbosus,* and *Thymus pulegioides* are all characteristic of commons and slopes with usually slightly acid to neutral soils. Their decrease in both areas must be due to the increasing growth of other species resulting from the diminished grazing.

Group 2 consists of 11 species, whose frequencies have remained unchanged in Borup Gade, while they have disappeared from or become very sparse in Tjørnestykket.

Seven of these species (subgroup 2a) are more or less oligotrophic, usually growing on acid soil poor in Ca. The average values of the edaphic factors for *Carex pilulifera, Deschampsia flexuosa, Festuca ovina, Galium saxatile,* and *Potentilla erecta* given by Hansen (1976) are very similar to the values found in Borup Gade, while especially the pH and Ca values are much higher in Tjørnestykket (table 3). Also *Sieglingia decumbens* and *Veronica officinalis* are oligotrophic species growing mostly on acid soil.

The liming of Tjørnestykket consequently must have been an important factor in the decrease of the species in subgroup 2a in this area. A contributory factor may be the stronger competition from the species of group 3 which have increased considerably in Tjørnestykket, but not in Borup Gade.

The average values of edaphic factors as given in Hansen and Jensen (1974) for 3 of the 4 species in subgroup 2b, viz. *Campanula rotundifolia, Hieracium pilosella,* and *Luzula campestris,* do not differ much from the corresponding values from Tjørnestykket. Like the 4th species, *Carex caryophyllea,* they are mostly found on slightly acid to neutral soil. Hence the decreased frequencies of these species in Tjørnestykket can not be directly due to the increased values of pH and Ca resulting from the liming. On the other hand, the liming has increased the frequencies of the more eutrophic species in group 3 (and species not mentioned analogous with them) in Tjørnestykket. Undoubtedly the increased competitive power of the more eutrophic species is the cause of the reduced frequencies of the species in subgroup 2b.

The 3rd group includes 5 species which, with the exeption of *Festuca pratensis,* were not listed in the analyses from 1919 and 1941. Today, however, they are rather frequent in Tjørnestykket, while in the communities in Borup Gade only a few individuals of *Deschampsia cespitosa* are found.

All the species are more or less eutrophic. The values of the edaphic factors for the species on roadsides (Hansen and Jensen 1974) are similar to those

in Tjørnestykket, but much higher than those in Borup Gade (table 3), especially so regarding pH, Ca and P. Hence, the increase of the species in group 3 in Tjørnestykket only must be caused mainly by the liming of this area.

The frequency of *Urtica dioeca* is rather low exept in community F (table 4). According to locals and some notes on Dyhre's maps from 1958, *Urtica dioeca* was much more dominant in Tjørnestykket before the area became part of the deer park in 1983. Its recent decrease may thus be caused by the strong partiality of the red deer for *Urtica dioeca*. The remaining individuals of which are all heavily bitten.

The three species given as examples of group 4, *Carex hirta, Poa pratensis,* and *Stellaria graminea*, all increased in both areas. The values for these species on roadsides (Hansen and Jensen 1974) are similar to the values in Tjørnestykket excepting P, but in Borup Gade not only P, but also Ca and pH are much lower. It is remarkable that while *Carex hirta* on roadsides is distinctly eutrophic with regard to P (Hansen and Jensen 1974), it thrives extremely well in both Tjørnestykket and Borup Gade where the content of P is extremely low compared with the roadsides.

Because all three species have increased in both areas, the increase can not be explained by the liming and fertilization in Tjørnestykket. More likely it is influenced by the increased wetnes of the areas during the last decades either directly or indirectly through the improved growth of food plants in general lessening the pressure of grazing.

The species representing group 5, *Achillea millefolium, Agrostis tenuis,* and *Festuca rubra* are species typical of the commons. They all appear as dominant in one or more communities in both areas, in the old as well as in the recent analyses. There might be some slight difference in their earlier and recent occurrence, but in broad outline they have been indifferent to the complex of ecological changes.

General conclusions

From the point of view of a farmer, Rejnstrup Overdrev has always been marginal land. The soil is mostly sandy and the great amount of boulders and stones makes ploughing and other cultivation difficult. In spite of this, the farmers have through the ages tried to exploit the area in different ways, more or less succesfully.

Cultivation was tried in Neolithic times as well as in the Pre-Roman Iron Age. However, the clearings were rather small and occupations were not maintained for any longer period. From about BC the forest of oak and beech covered most of the area.

There is no archaeological evidence of any use of the area between AD 100 and AD 700. However, the increase of beech in the forest, especially after AD 500, may suggest that pigs may have been present.

A more intensive utilization of the area began with the foundation of the village Borup about AD 700. Through the next more than 500 years great parts of the area were cultivated and other parts were used as pasture.

About AD 1250 most fields were deserted – possibly due to the deteriorating climate. However, the area was still used extensively partly as pasture for cattle and partly for pannage which were a good source of income for the manor.

After AD 1500 forest of beech and some oak covered the whole area, except for about 10 ha open grassland in the western part of Borup Gade.

According to the map this area was open land in 1791 and stayed so until present time, most likely because the more fertile old tofts of Borup offered better grazing than the rest of the area.

Pannage continued until well into the 18' century and remnants of a generation of beech germinated in the beginning of the 18' century still existed in the 1950'ies.

The "Forest-Ordinance of 1805" meant a great change for the area. Almost half of the area became protected forest, while the trees outside were felled and this area became farmland.

This farmland was used in different ways: cultivated fields, plantation, deer park, and pastures. The area of pasture varied in the course of time as did the number of grazing cattle.

Today only two lots of the ancient Rejnstrup Overdrev are grassland with a vegetation characteristic of commons: Borup Gade which since 1888 has been part of a deer park, and the southern part of Tjørnestykket which was used for cattle grazing from 1808 to 1983, at which time also this lot became part of the deer park.

From the 1940'ies Tjørnestykket was limed and fertilized. The different use and treatment of the two lots has meant a different development of their vegetation.

Borup Gade is almost without higher shrubs, the soil is still acid and rather unfertile. Many species characteristic of commons and slopes still grow there.

The soil of Tjørnestykket is now more fertile and less acid. The common is much overgrown with shrubs, especially hawthorn, roses, and elder. Many of the species typical of Danish commons have disappeared. However, very few trees of the forest have established themselves in Tjørnestykket and no new reproduction of trees was found in 1986.

The ability of the forest to regenerate has varied very much through the ages, depending on the size and duration of the clearings and their subsequent use.

Parts of the area were cultivated firstly in Neolithic times and secondly in Pre-Roman Iron Age but the forest covered still most of the area. In the centuries before AD 700 the proportion between forest and open land was equal to what it was about AD 1791, when the area was mapped (cf. Mikkelsen 1986, Tab. IV) indicating that the forest at that time covered most of the area.

The clearings and the cultivation beginning about AD 700 affected great parts of the area and were kept for a rather long time. However, when cultivation stopped about AD 1250 most of the area again became forest. The relatively quick regeneration of the forest in the late Medieval times undoubtedly was due to the pigs on mast.

In recent time there has been no regeneration of forest, neither in Borup Gade nor in Tjørnestykket, and the new forest in the other lots is planted.

In Borup Gade the deer have effectively prevented the shrubs and trees from developing, and in Tjørnestykket the rather intensive cattle grazing – every year – has impeded the formation of a continuous ring of spiny shrubs as a good bed for young trees.

The plant communities of slopes and commons are rapidly declining in Denmark. Some – among these Rejnstrup Overdrev – are protected. Unfortunately continued liming and fertilization of Tjørnestykket has been allowed with the result, as shown above, that quite a lot of the species characteristic of the commons have disappeared, but many of them are still present in Borup Gade.

Another problem for Danish commons is the overgrowing. The development of the two lots of common in Rejnstrup Overdrev seems to indicate that the use of them as part of a deer park also containing forest will keep them open grassland with several characteristic species preserved. Between 1808 and about 1940 cattle grazing also preserved the open common, but in the 19' century at any rate the cattle grazing was combined with the utilization of the shrubs for fencing and fire wood. The cattle alone can not prevent the overgrowth.

The red deer is extremely effective in preventing overgrowth, but when it is placed in an area with

heather it seems impossible to avoid a decrease of this species which now is characteristic of the most leached ant-hills of the common.

Undoubtedly the deer will keep the shrubs of the investigated area in check and so the values of the landscape and many characteristic species will be preserved. However, even if the fertilization of Tjørnestykket is stopped, all the typical species will undoubtedly be long in recovering in this area. It shall be interesting to follow the future development and the author sincerely hopes that this paper may serve as the basis for future and more intensive investigations.

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