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## Small forest parcels, management diversity and valuable coppice habitats: an 18<sup>th</sup> century political compromise in the Osnabrück region (NW Germany) and its long-lasting legacy

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This study underlines the often under-estimated importance of forest ownership and land tenure in European forest biodiversity studies which are crucial for the management, structure, and tree species composition of woodland. In particular it is assumed that, in regions with both state-owned forests and smaller private forests, the latter contain more relict habitats shaped by historical woodland management practices. A government decree of 1721, a political compromise, was crucial to the present-day woodland ownership pattern and distribution of woodland habitats in the Osnabrück region (northwest Germany). It resulted in the privatization of woodlands held in common for centuries and created a huge number of small, private forest parcels in the 18<sup>th</sup> century. These developments are discussed in relation to Europe-wide processes in forest affairs. Mainly due to the low economic importance of these forest parcels, as well as the individualism of the forest owners, coppice structures providing valuable habitats have persisted until today. For instance, over-aged coppice stands provide important habitat conditions for saproxylic species and unique herbaceous layers. These valuable habitats must be protected while creating new coppice stands to eventually take their place in future decades. Management plans for Natura 2000 sites in the Osnabrück region should address this problem while reconciling any conflict of interests between private owners and nature conservation organizations. Researchers are encouraged to give more consideration to the important relationship between current woodland biodiversity and the history of forest ownership patterns.

**Keywords:** Biodiversity Conservation, Forest History, Forest Ownership, Forest Policy, Historical Ecology, Land Tenure, Nature Conservation, Silviculture

### Introduction

In Europe, the current distribution patterns of woodland biotopes in the cultural landscape are the result of century-long human impact. Even woodland areas commonly regarded as “ancient”, “virgin” or “old-growth” forests feature a high density of remnants of human settlement and activity (Dupouey et al. 2002, Rackham 2003,

Bobiec 2012). Of particular interest are historical woodland management practices such as coppicing, coppicing with standards and wood-pasture, which have resulted in woodland habitats that are nowadays highly valued by nature conservation due to their rich biodiversity (Buckley 1992, Groß & Konold 2010, Müllerová et al. 2015). However, the cessation of forest manage-

ment, which is frequently demanded by conservationists, diminishes the relevant structures of culturally modified woodlands. Consequently, there is a conflict of interest in nature conservation (Lowenthal 2005, Kopecky et al. 2013, Müllerová et al. 2015).

On the regional scale, the structure of forest ownership and land tenure was frequently the main factor influencing the management, structure, and tree species composition of woodland (Steen-Adams et al. 2015, Rendenieks et al. 2015, Munteanu et al. 2016). However, the relationship between forest ownership patterns and woodland biodiversity is an often underestimated factor in European forest studies (Lovett-Doust & Kuntz 2001, Schaich & Plieninger 2013, Bergès et al. 2013). Especially from the late 18<sup>th</sup> century onwards, state-run forest management and management by large land owners frequently led to highly effective, profit-oriented forest use (Fritzböger 2004, Siiskonen 2007, Mölder et al. 2014). In contrast, the management in

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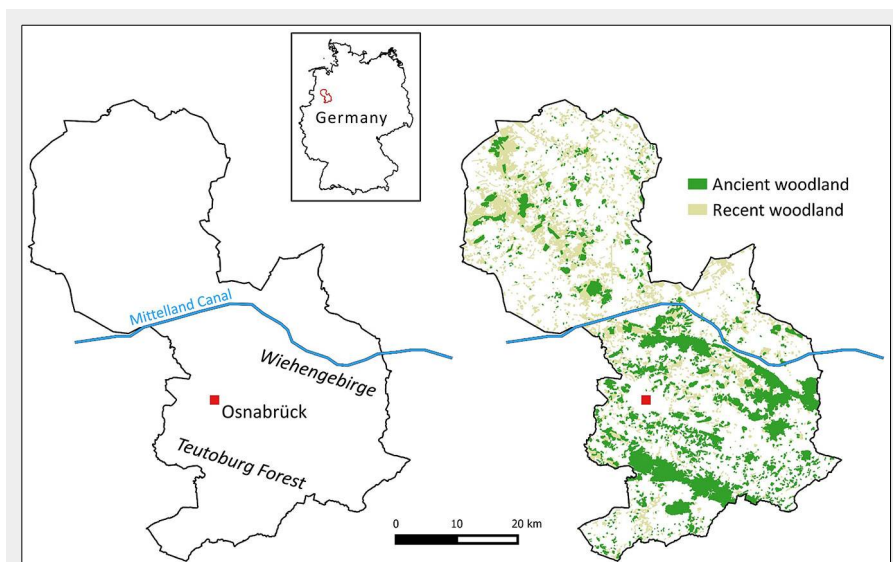
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**Fig. 1** - The Osnabrück region. Woodland that has been continuously wooded since at least AD 1800 is considered as ancient. The ancient woodland data set was provided by the Lower Saxon Forest Planning Agency (NFP). Basic geodata: BKG (2012).

cellent dissertation on the decline and division of the commons in the Osnabrück region from 1927. More recently, Hans-Joachim Behr and Stefan Brakensiek published relevant papers (Behr 1970, Brakensiek 1994, 2002).

In the Osnabrück branch of the Lower Saxony State Archive, documents from the 18<sup>th</sup> century forestry administration were obtained, in particular forest descriptions and detailed forest maps (indicated by “Rep” or “K” in Box S1 in the Supplementary material). Forest maps have been georeferenced and evaluated using QGIS 2.6 (QGIS Development Team 2014).

### Previous history: the management of common property resources

#### *Rise and height of the Markgenossenschaften*

#### Origins in the High Middle Ages

During the High Middle Ages, when the population grew and natural resources became increasingly scarce in north-western Germany, institutional regulations of the usage of common land (*Mark* or *Allmende* in German) turned out to be inevitable. From the 12<sup>th</sup> century onwards, the formation of so called *Markgenossenschaften* (cooperatives of the users of common land) was the usual solution (Middendorff 1927, Brakensiek 2002). Along with the establishment of the self-governing *Markgenossenschaften*, a complex legal system developed, determining the usage rights of the cooperative members and aimed at preventing the depletion and devastation of the land. Local courts (*Hölting* or *Markengericht*) were regularly held and visited by peasants and lords. The judges were lay judges (*Holzgraf* or *Holzrichter*, literally “wood judge”). These lay judges, as well as other persons who were granted privileged use of the common land (*Erbexen*), normally stemmed from the nobility. The local courts examined infringements of regulations and, since not all commoners had the same specific rights, controlled the graduated rights of usufruct. Offences were punished by fines (Klöntrup 1783, Stüve 1872, Middendorff 1927, Brakensiek 2002). Several legal relationships existed between the lords and the peasants, whereby the peasants were not personally free (*Eigenbehörigkeit*), but were provided with secure land usage rights and had access to legal institutions (Klöntrup 1798).

#### From the Middle Ages until the middle of the 16<sup>th</sup> century

Until the early 16<sup>th</sup> century, each *Markgenossenschaft* was a closed economic system and all goods derived from the *Mark* remained with the commoners. The regulations of the cooperative and the decisions of the periodic local courts were respected (Middendorff 1927, Brakensiek 2002). Most of the open land in the Osnabrück region was pasture, that was often carefully ma-

smaller private or communal forests frequently kept historical practices up and was less intensive (Wiersum et al. 2005, Siiskonen 2007, Von Lüpke et al. 2011). Throughout Europe, small private forests with a size up to 5 ha are very common (Schmithüsen & Hirsch 2010). It is assumed that in regions with both state-owned forests and smaller private forests the latter nowadays contain more relict species bound to habitats shaped by less intensive and historical woodland management practices (Schaich & Plieninger 2013).

But which kind of political decisions in the past led to the land tenure structures which are obviously so important for biodiversity patterns? Were there particular political events in the past that are still of importance for current woodland management and habitat conditions? How were these decisions justified, and what was their motivation and background?

To answer these questions, research was conducted in the Osnabrück region, which is part of the German federal state of Lower Saxony. This region is a very suitable study area due to a wealth of historical and ecological information and a mixture of smaller private and larger state-owned forests.

### Study area and material

#### *Study area: the Osnabrück region*

The Osnabrück region is situated in the south-western part of the German federal state of Lower Saxony and corresponds to the administrative district *Landkreis Osnabrück* with an area of 2121 km<sup>2</sup> (Fig. 1). In large parts, the Osnabrück region matches the former Prince-Bishopric of Osnabrück, which emerged in the Middle Ages and lost its autonomy when it became part of the Electorate of Hanover in 1802 (Stüve 1853, Behr 1970, Landkreis Osnabrück 2014). Na-

tural woodlands would be dominated by deciduous tree species, especially European beech (*Fagus sylvatica*) (Mölder 2009). The present-day forest cover of the Osnabrück region is 20% (42 878 ha), and the state forest area amounts to 6266 ha (Landkreis Osnabrück 2014, Mölder et al. 2015).

The landscape of the most southern part of the Osnabrück region is dominated by the northwest-southeast oriented Teutoburg Forest hill range reaching an altitude of 331 m a.s.l. (Fig. 1). About 20 km north of the Teutoburg forest, beyond a varied cultural landscape and the city of Osnabrück, the hill ranges of the Wiehengebirge (also northwest-southeast oriented) reach an altitude of 211 m a.s.l. While the low-lying parts of the surrounding landscape have been widely cleared for agriculture and settlements, the hill ranges feature a long continuity of woodland cover (Herzog 1938, Mölder 2009). In the northern lowlands of the Osnabrück region, ancient woodlands are scattered and embedded within an agricultural landscape. Many forest stands developed from 18<sup>th</sup> and 19<sup>th</sup> century (conifer) afforestation of poor quality sites (Herzog 1938, Hesmer & Schroeder 1963).

#### *Material: literature and historical sources*

In order to obtain information on past woodland conditions, forest management, historical developments, and political decisions, the relevant literature for the Osnabrück region was thoroughly reviewed. In addition to the works of the jurist, historian and politician Johann Carl Bertram Stüve (1798-1872 – Stüve 1853, 1872), those of the jurist Johann Aegidius Klöntrup (1755-1830 – Klöntrup 1783, 1798, 1799) appeared to be of special importance. The same is true for Rudolf Middendorff’s ex-

naged, e.g., by irrigation or the planting of trees for shadow (Stüve 1853, 1872, Middendorff 1927, Varwig 1951). Intensive wood-pasture seemed to be unusual, while pannage was very important. Of all the types of common land, woodland was subject to the strictest regulations, most probably due to the importance of pannage. This implies that there were sufficient mature oak (*Quercus robur*, *Q. petraea*) and beech trees in the woods. The cutting of wood for use as domestic timber or firewood was limited by the specific rights of the commoners and *Erbexen*. The woodlands were further used for grass cutting and litter collection (Klöntrup 1783, Stüve 1853, 1872, Middendorff 1927).

However, after being relatively stable until the 1450's, the population grew during the late 15<sup>th</sup> and the 16<sup>th</sup> century. The descendants of the long-established peasants (i.e., peasants being commoners since the establishment of the *Markgenossenschaften*) were frequently allowed to found homesteads in the still extensive common land.

### Decline and crisis of the *Markgenossenschaften*

#### Decades of war and overexploitation

From the 1550's onwards, armies marching through its territory placed economic and social burdens on the Prince-Bishopric of Osnabrück. Bad harvests, famines and plague outbreaks added to these problems, so that the economic conditions for the *Markgenossenschaften* worsened (Stüve 1872, Middendorff 1927, Varwig 1951). During this period the population was still growing and a new class of small peasants

(called *Heuerlinge*) developed, who rented a small piece of land from the long-established peasants and who were hired for agricultural work. Although they had no official rights to use the common land, their activities in the *Mark* were condoned (Klöntrup 1799, Middendorff 1927, Schlumbohm 1992, Brakensiek 2002).

At the same time, due to currency devaluation, the fines imposed by the local courts became negligible and lost their regulative power. The woodland was exploited through increasing wood utilization by the commoners, *Heuerlinge*, landlords and even by state authorities. Wood theft also occurred. Open land for pasture became scarce due to an increase in the arable land area and wood-pasture had to fill this gap. However, despite recurring complaints of woodland devastation in the 16<sup>th</sup> century, large irregular coppice-like woodland areas still existed around 1600 (Stüve 1872, Middendorff 1927, Schroeder 1963).

During the Thirty Years' War (1618-1648), the *Markgenossenschaften* and municipalities had to shoulder enormous financial and tangible burdens. In order to raise the necessary money, land from the *Mark* was sold, as well as large amounts of wood from the forest. The woodlands were also plundered by soldiers (Stüve 1872, Middendorff 1927, Winkler 1959, Hesmer & Schroeder 1963, Behr 1970, Brakensiek 2002).

#### "*Pax optima rerum*" - *etiam pro silva*?

The Peace of Westphalia, a series of peace treaties signed in Osnabrück and Münster, ended the Thirty Years' War in 1648. In accordance with the provisions of the Peace Treaty of Osnabrück (Article XIII) and the rulings of the Diet of Nuremberg in

1650, the "perpetual capitulation" (*Capitulatio Perpetua Osnabrugensis*) was installed. Henceforth, the Prince-Bishopric of Osnabrück was alternately reigned by Catholic and Lutheran prince bishops. All Lutheran prince bishops (strictly speaking, they were diocesan administrators) had to be descended from the House of Brunswick-Lüneburg. This "alternative succession" was kept until the Prince-Bishopric lost its autonomy in 1802 (Sautmann 2002, Steinert 2003 – Tab. 1).

Although the *Capitulatio Perpetua Osnabrugensis* included a paragraph on forest protection, conditions in the woodlands worsened in the postwar period. As a consequence of an economic upturn, the population grew further. This development was welcomed by the state, since the tax revenues increased and economic strength grew (Winkler 1959, Schlumbohm 1992). Although the woodlands were exposed to increasing overexploitation, the government took no regulatory action until 1671. In this year, the first Lutheran prince bishop, Ernest Augustus I (reign 1662-1698), presented the draft of a forest decree (Klöntrup 1799, Middendorff 1927, Winkler 1959, Spannhoff 2011).

This forest decree aimed at restoring the undermined *Markgenossenschaften* system. The prescriptions concerned the regulation of the local courts, the designation of boundaries, the protection of woodland, afforestation, the enhancement of governmental control, and the reduction of the *Erbexen*'s rights. The area of application were those *Markgenossenschaften*, where the Prince Bishop held the *Holzgraf* position. The enactment of this decree was observed in the *Marken* of the Iburg district,

Tab. 1 - Prince-bishops of Osnabrück between 1625 and 1802 and major events in forest affairs.

| Reign     | Prince Bishop /<br>Diocesan Administrator                                  | Confession | Year      | Event  |
|-----------|--|------------|-----------|--|
| 1625-1661 | Franz Wilhelm von Wartenberg   | Catholic   | 1648      | Peace of Westphalia  |
|           |  |            | 1650      | Commencement of the <i>Capitulatio Perpetua Osnabrugensis</i>  |
| 1662-1698 | Ernest Augustus I  | Lutheran   | 1671      | The draft of a forest decree is presented, the estates prevent its enactment   |
|           |  |            | 1697      | The estates prevent the enactment of a forest decree   |
| 1698-1715 | Charles Joseph of Lorraine   | Catholic   | 1699      | The estates prevent the enactment of a forest decree   |
| 1716-1728 | Ernest Augustus II   | Lutheran   | 1716      | The estates prevent the enactment of a forest decree   |
|           |  |            | 1717      | The estates present a report listing the reasons for woodland deterioration  |
|           |  |            | 1721      | 21 April: The division of the commons is proposed in a <i>Landtag</i> (diet) proposition                                 |
|           |  |            | 1721      | 14 July: Decree regarding the division of the commons  |
| 1728-1761 | Clemens August of Bavaria  | Catholic   | -         | Conduction of several "open divisions" of common woodland  |
| 1764-1802 | Frederick Augustus,<br>Duke of York and Albany                             | Lutheran   | 1765      | Justus Möser writes a <i>pro memoria</i> on the improvement of forestry and forest registers                             |
|           |  |            | 1766      | Appointment of a central forest administrator ( <i>Oberförster</i> )   |
|           |  |            | 1760's    | Spruce and Scots pine are introduced   |
|           |  |            | 1777/1778 | Description of the state-owned forests   |
|           |  |            | 1780's    | The government begins to hand out seeds of spruce and pine to the peasants   |
|           |  |            | 1778      | A premium is awarded for the first two <i>Markgenossenschaften</i> that decide to completely privatize their common land |
| 1785      | 4 June: Decree on the procedure of the complete dissolution of the commons |            |           |  |



but failed in most areas due to the opposition of the estates (Klöntrup 1799, Middendorff 1927, Spannhoff 2011). The estates (*Landstände*) consisted of representatives from the nobility, the cathedral chapter, and four cities (Renger 1968). In the year 1697, Ernest Augustus I tried again to establish a forest decree. His successor, the Catholic prince bishop Charles Joseph of Lorraine (reign 1698-1715) had a similar intention in 1699. Both attempts failed, again due to the opposition of the estates (Middendorff 1927, Behr 1970).

## Division and privatization of the common woodland

### The “Decree regarding the division of the commons” from 1721

In 1716, the second Lutheran prince-bishop Ernest Augustus II (1674-1728) failed to establish a forest decree, too (Tab. 1). The estates objected to restrictions of the *Erbexen's* rights and to any strengthening of the rights of the *Holzgraf* (Middendorff 1927, Behr 1970). In 1717, the estates presented a report that listed the reasons for woodland deterioration (Middendorff 1927): “[...] sod-cutting and mowing of heath and litter raking between the trees, which withdraws nutrition from the roots, changes the moisture conditions”, and means that the cattle are forced to “browse any young trees that haven't already been cut”. The small peasants were also mentioned, who “take their fuelwood *per fas et nefas* from the woods. The *Marken* have deteriorated with an increase in their number [...]”.

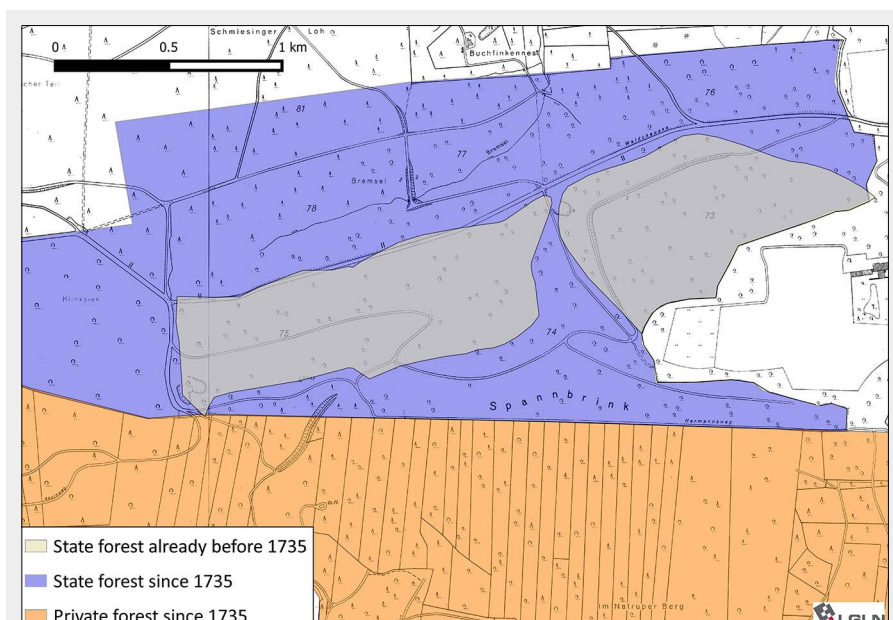
Since he was not able to stop the decline of both the *Markgenossenschaften* and their woodlands by administrative measures, Ernest Augustus II looked for alternative solutions. The privatization of the common woodlands appeared to be a feasible approach (Middendorff 1927, Behr 1970). During these years, the *Markgenossenschaften* of Iburg and Laer in the Iburg district already aspired to “open divisions” (see below) of their common woodland (Middendorff 1927, Sautmann 2002). Hence, in a *Landtag* (diet) proposition from 21 April 1721, it is stated (Lodtmann 1819, Middendorff 1927): “Since a division of the commons prevents several hitherto commonly noticed inconveniences and quarrels, particularly the worrying and almost daily worsening wood shortage, His Royal Highness has no doubt that Your faithful estates will agree to, and bring together and establish whatever is appropriate to institute this intention.” The estates welcomed the idea of dividing the common woodlands, but they demanded survey reports on this project from the *Holzgrafen*. Thereupon Ernest Augustus II issued a “Decree regarding the division of the commons and the projects, which the *Holzgrafen* have to send concerning this matter” on 14 July 1721 (Lodtmann 1819, Middendorff 1927). This decree states that “We have, upon the advice of Our faithful estates [...], graciously resolved that the division of the commons should be accomplished in such a manner that nobody is disadvantaged in his authorities and servitudes which are connected to the common land. We command all *Holzgrafen* of Our

principedom, in order to support this work of common public interest, to present a survey report that describes the suitable implementation of this beneficial work taking into account the local conditions [...]”.

### “Open divisions” of common woodland

However, the reports of the *Holzgrafen* were not positive. A systematic division of the common woodlands appeared to be unrealistic, particularly due to the estates' opposition against any governmental force (Middendorff 1927, Behr 1970). But, as Middendorff (1927) states, both the need for changes in the invidious conditions and the “pressing wood shortage” led to “open divisions” of the common woodlands. In the case of an “open division”, the legal system and the instructions of the *Markgenossenschaften* remained intact and only the forest stands (including wood harvesting, pannage, sod cutting, and litter raking) were privatized. Wood-pasture remained common, thus the peasants, *Erbexen* and even the state were not allowed to fence their new private forest property. Only one quarter of each parcel could be enclosed by a fence for four years to protect young tree plantings (Klöntrup 1799, Middendorff 1927, Behr 1970, Sautmann 2002).

Since there were no special instructions for the division of the common woodlands until 1785, the government determined the necessary instructions from case to case. Generally, the dividing process was as follows: the basic calculation unit of the dividing process was the *Erbteil* (literally “inherited share”), where 1 *Erbteil* corresponded to 1 *Ware*. The extent of a *Ware* expressed the extent of (usage) rights which each farmstead and the indwelling peasants had in a *Markgenossenschaft*. Normally, the long-established farmsteads held 1 *Ware* (*Vollerben*) or 5/6 - 1/2 *Ware* (*Halberben*), while younger farmsteads owned 1/2 - 1/3 *Ware* (*Erbkötter*) or 1/3 - 1/4 *Ware* (*Markkötter*). The small peasants (*Heuerlinge*) held no *Ware* at all (Klöntrup 1798, 1799, Herzog 1938, Schlumbohm 1992). During the dividing process, the total woodland area of a *Mark* was divided by the total number of the full *Erteile* in order to calculate the area equivalent of an *Erbteil*. To achieve equality of the privatized forest stands with regard to stand and site quality, the respective woodlands were classified into good and bad parts and every commoner received both good and bad quality forest parcels (Fig. 2). How much woodland property every commoner got, was dependent on the extent of his *Ware*. The woodland parcels were frequently allocated by lot. In the *Mark* of Glane in the Iburg district the lots were drawn by a child (Klöntrup 1783, Middendorff 1927, Sautmann 2002). To pay the costs of the dividing process, parts of the common land were sold. In the *Marken* of the southern Osnabrück region, where the Prince Bishop



**Fig. 2** - The Spannbrink area in the Teutoburg Forest. The woodlands of the *Markgenossenschaft* of Hilter have been divided in 1735. Please note the small-scale mixture of coniferous and broadleaved woodland in the private forests (see also Fig. S2 in Supplementary Material). The map was provided by the *Landesamt für Geoinformation und Landesvermessung Niedersachsen* (LGLN, © 2015), the historical information was derived from K 73 Nr. 108 H (Box S1 in Supplementary material).



held the *Holzgraf* position, the state normally received 12 *Erbteile* per woodland division. Since the government was able to select the future state forest areas without restrictions, either existing state forests were enlarged or the new property was pooled along the borderlines of neighboring *Marken*. In this way, large blocks of state forest were created (Middendorff 1927, Herzog 1938, Behr 1970 – Fig. 2).

During the long reign (1728-1761) of the Catholic prince-bishop Clemens August of Bavaria, forest affairs were widely neglected in the Prince-Bishopric of Osnabrück. However, before 1778, 17 “open divisions” were conducted. Due to these woodland privatizations, the state-owned woodland area increased from ca. 470 ha to ca. 1275 ha (Behr 1970, Rep 110 II Nr. 219 – Box S1 in Supplementary Material).

#### Complete divisions of common woodlands and dissolution of the *Markgenossenschaften*

Under the reign (1764-1802) of the third Lutheran Prince-Bishop Frederick Augustus, Duke of York and Albany (1763-1827), forestry issues were again regarded as important by the government (Tab. 1). The key personality behind this development was the lawyer and statesman Justus Möser (1720-1794). Möser had a strong, conciliatory influence both on the estates and the state administration under the custodial government of George III (1738-1820), prince-elector of Brunswick-Lüneburg and King of Great Britain and Ireland. The latter led the government in the place of his underage son Frederick Augustus (Renger 1968). Due to the initiative of Möser, the state-owned woodlands were charted, des-

cribed and marked with boundary stones and ditches (Fig. 3). These measures, together with the establishment of a proper forest administration in 1766, made it possible to implement the principles of modern forest management in the state forests (Middendorff 1927, Behr 1970, Vogelpohl 2014, Mölder et al. 2015, Rep 110 I Nr. 334 – Box S1 in Supplementary Material). In the 1760's, spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) were introduced and in the following years increasingly cultivated (Herzog 1938, Hesmer & Schroeder 1963). Surveys in 1777/1778 and 1788-1790 showed that the condition of the state-owned woodlands was not as bad as feared. However, due to the “open divisions” of the common woodland, most of the state forests were still used as wood-pasture (Behr 1970, K 73 Nr. 108 H, K 73 Nr. 110 H, Rep 110 II Nr. 219 – see Box S1 in Supplementary Material).

In order to promote the complete division and privatization of the commons, the government awarded a respectable premium in 1778 for the first two *Markgenossenschaften* that decided to completely privatize their common land. To induce a division, the *Erbexen*, the *Holzgraf*, and 2/3 of the commoners had to agree, whereby the votes were weighted according to the *Ware* held by each commoner. Subsequently, a great number of divisions were initiated. In order to facilitate the implementation of these divisions, a decree on the procedure of the complete dissolution of the commons was issued on 4 June 1785. The proportion of commoners who had to agree was changed to a simple majority. The government refused to apply coercive measures and acted on the as-

sumption that the commoners themselves would recognize the need to privatize the commons. Here, the good examples of successfully divided commons were regarded to be a facilitating factor (Klöntrup 1799, Lotdman 1819, Middendorff 1927).

The government took several measures to promote forest management in the new private woodlands. Seeds of spruce and pine were handed out free to the peasants and premiums were awarded for the largest tree nurseries. Additionally, especially in the northern parts of the Osnabrück region where drifting sand was a problem, the containment and afforestation of many areas was supported (Hesmer & Schroeder 1963, Behr 1970).

Due to the political upheavals in the first quarter of the 19<sup>th</sup> century, the process of dividing the commons lasted for decades, and after the last *Markgenossenschaft* was completely dissolved in 1873 the private woodlands in the Osnabrück region consisted of countless small woodland parcels (Herzog 1938). However, the multitude of small peasants, who were once tolerated as co-users of the common land, were not considered at all when the land was divided among the long-established commoners (Schlumbohm 1992, Sautmann 2002).

#### Discussion

##### *A political compromise from 1721 with far-reaching consequences*

According to the current state of research, it appears that the *Markgenossenschaften* managed the common land in a relatively sustainable manner until the early modern period (Mantel 1968, Radkau 1983, Brakensiek 2002, Radkau 2011). The



**Fig. 3** - Historical remains at the boundary between state-owned and private forests. (a) Boundary ditch and boundary bank in the Großer Freeden area, Teutoburg forest. Spruce-dominated private forest on the left hand site and a broad-leaved stand in the state-owned forest on the right hand site of the boundary. (b) Boundary stone from 1777 in the Spannbrink area, Teutoburg Forest. “F” stands for prince-bishop Frederick Augustus, Duke of York and Albany (1763-1827). All photos by the author.

*Markgenossenschaften* remained intact for hundreds of years due to functioning socio-political control mechanisms, which are now recognized as Ostrom's design principles of stable local common pool resource management (Ostrom 1990, Van Gils et al. 2014). But at the latest after the Thirty Years' War, the *Markgenossenschaften* were no longer viable. A causal complex of war, population growth, and ineffective regulations had resulted in a decline of the traditional system of common land use. The *Markgenossenschaften* faced an existential crisis and the common woodlands suffered from increasing over-utilization (Stüve 1872, Middendorff 1927, Behr 1970, Brakensiek 2002). After several unsuccessful attempts were made to establish general forest decrees, woodland privatization seemed to be the only reasonable solution to ensure future wood supply. The 1721 decision to privatize the common woodland can be seen as a consequence of an intellectual current that later became known as "agrarian individualism" (Von Dücker 1870, Middendorff 1927, Behr 1970, Brakensiek 1994).

In retrospect, the reign of Ernest Augustus II was often appreciated as beneficial for both the state and the population (Bär 1904, Sautmann 2002). Ernest Augustus II was, however, an absolute ruler in the Baroque Age, and his attempts to obtain woodland properties through his rights as *Holzgraf* or *Erbexer* can also be seen as a means to establish, increase and safeguard his territorial sovereignty (Brakensiek 2002, Fritzboeger 2004). Unlike other sovereigns of the period though, he did not rule unopposed. The estates held strong political positions and were able to prevent the prince-bishop from abolishing their privileges, e.g., as *Holzrichter* or *Erbexer* (Renger 1968). As a consequence, the decree from 1721, which formed the legal base for the division and privatization of the common woodlands, appears to be a compromise between the prince-bishop, the estates, and even the long-established commoners. Since the estates argued against governmental force for the division of the common woodland, the division of the woodland had to be requested by the commoners, the *Holzgraf* and the *Erbexer* (Middendorff 1927).

One very problematic result of this compromise between the prince-bishop and the estates was the "open division" of common woodland. Klöntrup (1799) stated that this ineffective method of dividing common woodlands should be forbidden. Due to the interdiction of long-term enclosure young trees were still browsed by cattle, and even motivated forest parcel owners had problems ensuring the regeneration of their forest stands (Klöntrup 1799, Middendorff 1927, Behr 1970, Rep 110 II Nr. 219 – see Box S1 in Supplementary Material).

In order to promote the complete division of the commons, and therewith the

abolishment of the *Markgenossenschaften*, the administration awarded premiums and renounced the collection of compensation payments for the state (Klöntrup 1799, Middendorff 1927, Behr 1970). This shows that the *Markgenossenschaften* as organizations were still of some importance in the 18<sup>th</sup> century. In other northwest German territories they had already lost their character as self-governing co-operatives in the 16<sup>th</sup> century (Brakensiek 2002). For the old-established peasants private property appeared to be an instrument of power against the growing number of landless peasants (*Heuerlinge*), and they increasingly supported the complete abolishment of the *Markgenossenschaften* (Brakensiek 1994, Radkau 2011). The division of the commons had taken a vital share of the agrarian resources away from the *Heuerlinge*. Together with a decrease of the protoindustrial linen production in the middle of the 19<sup>th</sup> century, this resulted in an existential crisis for the underprivileged *Heuerlinge* class. Riots and emigration to America were some of the consequences (Schlumbohm 1992, Sautmann 2002).

#### *Regional developments embedded in a larger context*

As the analysis clearly showed, a stronger commitment to forestry issues is linked to the reign of Lutheran prince-bishops on the ducal House of Brunswick-Lüneburg. In the Electorate of Brunswick-Lüneburg (colloquially Electorate of Hanover) forestry had a high priority, mainly due to its importance for mining (Kremser 1990). As a result of the personal interconnections with the Prince-Bishopric of Osnabrück, forestry issues were also promoted in this territory. In contrast, the Catholic prince-bishops had no interest in forestry issues, apart from hunting, a great passion of the splendor-loving prince-bishop Clemens August of Bavaria (Hocker 1997).

There is evidently a connection between the division of the common woodlands, which were initiated in the Prince-Bishopric of Osnabrück earlier than in the neighboring territories (Riepenhausen 1986, Brakensiek 1994), and the Personal Union between the Electorate of Hanover and the Kingdom of Great Britain (1714-1837). Prince-bishop Ernest Augustus II was the youngest brother of George I (1660-1727), King of Great Britain and Ireland and Elector of Hanover, and it can be assumed that the idea of dividing the commons ("enclosure movement") came from London to Osnabrück and Hanover (Middendorff 1927). As Brakensiek (1994) states, Central European bureaucracies in the 18<sup>th</sup> century attached great hopes to the partition of common lands, since they regarded England and the success of the British "agricultural revolution" (Overton 1996) as a model. The land reforms were expected to lead to an increase in the population, the expansion of land under cultivation, and a real estate market. However, the only area

where the reforming officials registered continuous success was the population increase (Brakensiek 1994).

The process of dividing the common woodlands in the Osnabrück region included the use of lots in land distribution. This approach is very old and can be traced back to the Roman Republic, when sortition was used to allocate land equitably among the settlers in newly founded colonies (Campbell 1995). With regard to commons worldwide, lottery has been shown to be a widely-used method for allocating common property rights to fishing berth, pastoral commons, and common timber resources within relatively closed communities (Ostrom 1990, Boyce 1994). The allotment of land to European settlers in North America in the 18<sup>th</sup> and 19<sup>th</sup> century was also frequently determined by lottery (Price 1995).

When land reforms started in the Prince-Bishopric of Osnabrück in 1721, the main official justification for the division and privatization of the common woodlands was "an increasing shortage of wood". Although there is no question that, in general, the *Markgenossenschaften* were in crisis in the 18<sup>th</sup> century, and that the woodlands were exposed to increasing over-utilization, it is doubtful that an alarming "wood shortage" really occurred in the Prince-Bishopric of Osnabrück. One argument against an actual "wood shortage" are official woodland descriptions for the Iburg district from the 1770's, which not only include the original state forests, but also those forest stands that became state property after the division of the common woodlands. These descriptions stated that "the forest stock is quite good in the greater part of these woodlands", although there were also forests in poor condition in the vicinity of roads or settlements, or on nutrient-poor sites (Herzog 1938, Rep 110 II Nr. 219 – Box S1 in Supplementary Material). The various historical sources are rather inconsistent on this topic. This corresponds with the findings of Radkau (1983, 2011) and Warde (2006), who stated that Europe-wide complaints of wood shortages were more often a political instrument than reality. Another argument is that already in the 15<sup>th</sup> century coal was being mined in the Prince-Bishopric of Osnabrück and mining was strongly promoted during the reign of Ernest Augustus II (Grebing 2001). Hence, an alternative to wood as a fuel was available quite early, which can be assumed to have reduced the pressure on woodland.

#### *The long-lasting implications of common woodland privatization and parceling*

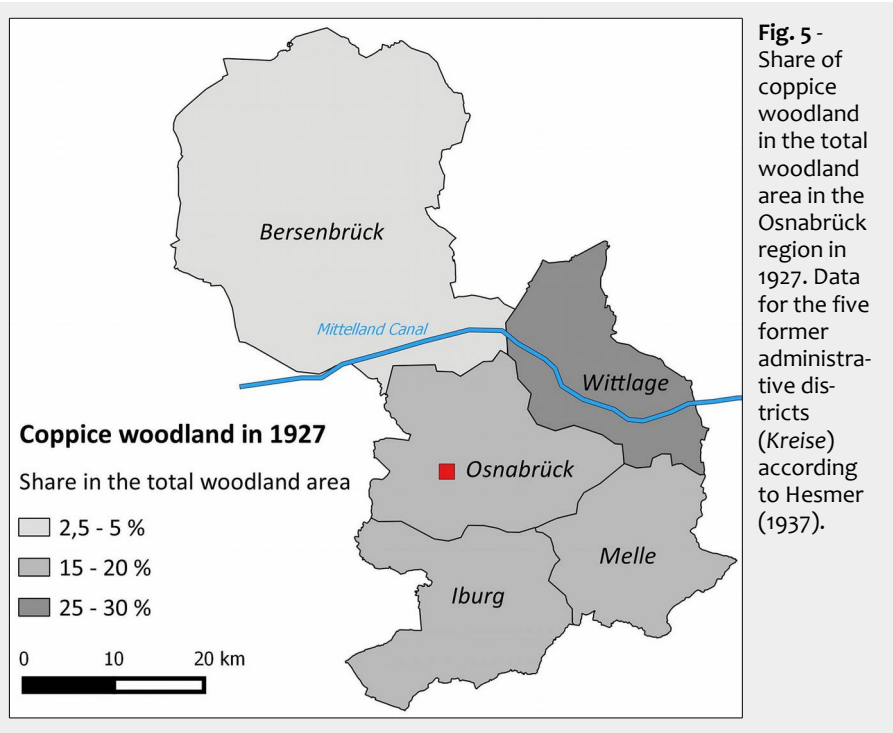
##### **Implications for forest management**

In the private forests, the division of the common woodlands created a difficult situation for forest managers. The division procedure was aimed at satisfying the dif-



ferent demands of the commoners but disregarded the requirements of future forest management (Burckhardt 1867, Von Dücker 1870, Middendorff 1927, Herzog 1938). In contrast to the situation for arable land, a land consolidation was not conducted in the private woodlands, so that the extreme parcelling of the private forests has persisted until the present time (Fig. 2). As in other regions, this parcelling resulted in a very high diversity of management approaches, management intensities, and tree species (Von Lüpke et al. 2011, Schlich & Plieninger 2013, Rendenieks et al. 2015 – Fig. 4, Fig. S1 and Fig. S2 in Supplementary Material).

While the conifer proportion in the private woodlands was already increasing in the 19<sup>th</sup> century, especially on acidic and nutrient-poor sites, up to 30 % of the woodland area remained active coppice stands until the middle of the 20<sup>th</sup> century (Hesmer 1937 – Fig. 5). The rotation cycle was ca. 30 years in the beech-dominated coppice stands and fuelwood was an essential resource. After WW II, the interest of many forest owners in their coppice stands de-



**Fig. 4 -** Management approaches and intensities in the Osnabrück region. (a) Unmanaged and overaged private beech coppice stand, Spannbrink area (Teutoburg Forest). (b) Recent harvesting activities in an old private beech coppice stand, Spannbrink area (Teutoburg Forest). (c) Small scale clear-cut in a private forest with replanted spruces, Kleiner Berg area (Teutoburg Forest). (d) Private former coppice stand that has been developed towards a high-forest structure by the promotion of only one sprout per coppice stool, Kellenberg area (Wiehengebirge). Photos a-c by the author, photo d by Volker Tiemeyer.



creased due to low-priced fossil fuels. Many coppice stands were transformed to conifer stands in this period (Ig Teuto 2012, Tiemeyer et al. 2012 – Fig. S1 in Supplementary Material). These developments are similar to those in other parts of Europe (Fuller & Warren 1993, Müllerová et al. 2015, Lassauce et al. 2012). However, many old coppice stands have persisted until the 21<sup>st</sup> century. The management intensities range from regularly harvested stands to stands that have remained unused for several decades. Some coppices have been developed towards a high-forest structure by the promotion of only one sprout per coppice stool (Fig. 4, Fig. S1 in Supplementary Material). The cultivation of valuable broadleaved tree species such as wild cherry (*Prunus avium*), sycamore (*Acer pseudo-platanus*), and Norway maple (*Acer platanoides*) was also facilitated (Ellerbrock 1980, Tiemeyer et al. 2012). Currently, the interest of the private forest owners in their stands is increasing again, due to high wood prices and initiatives that promote the use of wood as a renewable energy source. Not only conifer stands, but also old, long unused coppice stands are being harvested again, the latter mainly for domestic firewood (Schneiderbernd 2010, Ig Teuto 2012, Tiemeyer et al. 2012).

Hence, the preservation of coppice woodlands in the private forests of the Osnabrück region can be regarded as a consequence of the division of the common woodland in the 18<sup>th</sup> century. The state forest, in contrast, was increasingly managed as high forest from that period on (Herzog 1938, Behr 1970).

At present time, the private forest owners in the Osnabrück region are organized into Forest Protection Associations (*Waldschutzgenossenschaften*), which can sell larger amounts of wood. They are advised by foresters employed by the Chamber of Agriculture (*Landwirtschaftskammer*). The administration and coordination of the numerous forest owners and the planning of harvesting operations and wood transportation is a complex task (Viergutz 2011). Some forest owners are not aware that they own a forest parcel or have no commercial interest in their piece of woodland. The latter benefit from cultural ecosystem services such as recreation and aesthetic experience, rather than from the cutting of wood (Plieninger et al. 2015). As a consequence, the felling volume is relatively low (Viergutz 2011). With regard to the federal state of Lower Saxony in total, the mean annual harvest rate in small private forests (<20 hectares) is only 3.4 m<sup>3</sup> per hectare, while in larger forest enterprises (>20 hectares) between 5.7 m<sup>3</sup> and 7.0 m<sup>3</sup> are being harvested per hectare per year (ML Niedersachsen 2014). Already Burckhardt (1867) and Von Dücker (1870) recommended the re-establishment of forest owner cooperatives to foster a more coordinated and economic forest management. However, the (once favoured) individualism of

forest owners has hindered such attempts until today.

#### Implications for nature conservation

Due to the variety of small scale management approaches and intensities, ranging from unmanaged and overaged coppice stands to spruce stands with small clearcuts, a diverse habitat mosaic has developed in the private woodlands of the Osnabrück region (Burrichter 1953, Ellerbrock 1980, Pott 1981, Tiemeyer et al. 2012 – Fig. 4, Fig. S1 and Fig. S2 in Supplementary Material). This habitat pattern is in contrast to the larger forest units in the state forests, which are treated according to well-defined management plans (Mölder et al. 2015). In keeping with the environmental heterogeneity hypothesis (Huston 1994), these differences between both forest ownership types can be expected to result in a higher biodiversity in the private forests than in the state-owned forests (Schaich & Plieninger 2013, Rendenieks et al. 2015). Further studies are needed to confirm this assumption for the Osnabrück region. In the state forests, conservation measures should preserve and develop the typical diversity of semi-natural deciduous woodlands in larger spatial units. This is, for instance, done in the strict forest nature reserve “Großer Freeden”, which was established in 1972 and currently covers an area of 41 ha in the Teutoburg Forest (Mölder et al. 2009 – Fig. S1 and Fig. S2 in Supplementary Material). In the parcelled private woodlands, however, nature conservation measures should focus on the characteristic habitats shaped by the smallholder’s (traditional) woodland management practices. Tiemeyer et al. (2012) present a constructive conservation approach that focuses on the protection of valuable structures and supports voluntary arrangements with the forest owners. This approach was implemented in the Kellenberg area in the eastern parts of the Wiehengebirge (Fig. 4, Fig. S1 in Supplementary Material), where the forest owners show a willingness to contribute stands or objects (e.g., veteran trees, cavity trees, and coarse woody debris) to a voluntary conservation network.

One very valuable habitat type in the private woodlands of the Osnabrück region are the old beech-dominated coppice stands (Fig. 4, Fig. S1 in Supplementary Material), which are frequently mixed with hornbeam (*Carpinus betulus*), oaks, wild cherry, and maples (Burrichter 1953, Pollmann 2000, Ig Teuto 2012). The often large coppice stools can be older than 100 years and are therefore regarded as indicators of habitat continuity (Pott 1981). Together with dead sprouts, they provide large amounts of coarse woody debris or microhabitats such as rot-holes (Fuller & Warren 1993, Tiemeyer et al. 2012, Lassauce et al. 2012). For these reasons, over-mature coppices are frequently populated by specialized bryophytes, fungi, slugs, and sapro-

xylic beetles (Fuller & Warren 1993, Lassauce et al. 2012). Some parts of the Teutoburg Forest south of Osnabrück are mentioned by Speight (1989) as being of “potential international importance” due to their saproxylic invertebrate fauna. Ludger Schmidt (personal communication) recently found the “Urwald relict species” *Aeletes atomarius* (Müller et al. 2005), a specialized saproxylic beetle, in this area. However, the occurrence of very specialized saproxylic beetles in currently over-aged coppices is dependent on long-time ecological continuity in the vicinity of the stands (Mölder et al. 2014).

The beech-dominated coppice woodlands in the Osnabrück region often show a typical, diverse herbaceous vegetation, particularly on sites in the Teutoburg forest with limestone- and loess clay-derived soils. While recently harvested stands are characterized by a species-rich mixture of forest plants and light-demanding species, the herbaceous vegetation of old coppice stands is different from that of beech high forest stands in the vicinity (Burrichter 1953, Ellerbrock 1980, Pott 1981, Pollmann 2000, Mölder & Schmidt 2006). Floristic elements of oak-hornbeam forests (*Stellario-Carpinetum*) frequently occur in the coppice stands, in particular semi-shade plants such as *Stellaria holostea*, *Vinca minor*, *Primula elatior*, and *Rumex sanguineus*. The occurrence of these species can be linked to wet soil conditions and compaction resulting from coppice management, which regularly exposes the soils to reduced transpiration and increased precipitation (Pott 1981). Some coppice stands can be assigned to the rare sedge beech forests community (*Carici-Fagetum*), the characteristic plants of this plant community are *Cephalanthera damasonium*, *Viola hirta*, *Primula veris*, and *Neottia nidus-avis* (Pollmann 2000).

At the present time, most of the coppice stools in the over-aged coppices have lost their ability to resprout and regional techniques for creating new coppice stools have not been applied for decades. Hence, without counteractive measures, the unique coppice habitats will be replaced by high forests in the coming decades (Ellerbrock 1980, Pott 1981, Pollmann 2000, Ig Teuto 2012, Tiemeyer et al. 2012). Since considerable areas of the coppice woodlands in the Osnabrück region are part of the Natura 2000 network, the relevant management plans must address this problem (Mairota et al. 2015). Due to the currently increasing demand for fuelwood, the reactivation of coppice management for fuelwood production can be a possible solution (see above), if the characteristic habitat features of the coppice woodlands are preserved (Groß & Konold 2010, Müllerová et al. 2015). However, changed social and environmental circumstances can complicate such attempts, as experiments on the reactivation of coppice management in the vicinity of the Osnabrück region demon-



strate (Schniederbernd 2010). Currently, there are conflicts between nature conservation organizations and private forest owners. As a result of nature conservation constraints, the forest owners feel limited in their freedom of decision (NABU 2012, Habben 2014).

## Conclusion

The governmental decree of 1721, which was a political compromise, is directly responsible for the present-day woodland ownership pattern and the distribution of woodland habitats in the Osnabrück region. The decree ruled that woodlands which were owned in common for centuries should be privatized fairly. As a result, a huge number of small private forest parcels were created in the 18<sup>th</sup> century. Such developments are in keeping with Europe-wide forest history. Mainly due to the low economic importance of the forest parcels and the individualism of the forest owners, coppice structures have survived until today. Consequently, a compromise made nearly 300 years ago has resulted in the conservation of valuable coppice habitats worthy of protection, although it has also created some difficulties for modern forest managers. However, these stands are now over-aged and appropriate conservation management strategies are needed.

This research supports the assumption that small private forests support a larger variety of habitats than larger forest management units and details the historical background leading to this difference. It underlines the importance of forest ownership and land tenure in shaping forest development and woodland habitats. Future researchers are encouraged to give more consideration to the important relationship between current woodland biodiversity and the history of forest ownership patterns.

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## Supplementary Material

**Box S1** - Documents from the Osnabrück branch of the Lower Saxony State Archive.

**Fig. S1** - Management approaches and intensities in the Osnabrück Region.

**Fig. S2** - Structural diversity in the Teutoburg Forest.

**Link:** [Molder\\_1834@suppl001.pdf](mailto:Molder_1834@suppl001.pdf)