Forest management, ecological continuity and bird protection in 19th century Germany: a systematic review

(With 9 Figures)

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Baumschutz; Baumveteranen; Biodiversität; Habitatbäume; Habitatkontinuität; Eiche; Forstgeschichte; Naturschutz; Quercus; Vogelschutz.

1. INTRODUCTION

The ecological conditions of Central European forests are mostly an expression of past woodland management practices. Not only previous decisions on tree species composition, but also varied treatments of stand and habitat structures have had long-lasting effects on plant and animal assemblages (ELLENBERG and LEUSCHNER, 2010; MÜLLEROVÁ et al., 2014; KIRBY and WATKINS, 2015; MCGRATH et al., 2015). This is particularly true for specialized woodland species that are dependent on the long-term continuity of over-mature trees, deadwood and site conditions. These specialist species can be found among the saproxylic beetles, slugs, vascular plants, bryophytes, lichens and fungi (ROSE, 1999; KÖHLER, 2000; KAPPES, 2011; NORDÉN et al., 2014; WINTER et al., 2015). Especially oaks (*Quercus robur*, *Q. petraea*), with their long natural life span of between 300 and 900 years, offer suitable and long-lasting habitats for a variety of saproxylic and other narrow-niched species, including many oak specialists (HARDING and ROSE, 1986; BRÄNDLE and BRANDL, 2001; ELLENBERG and LEUSCHNER, 2010). Anthropogenic disruption of the ecological continuity was a common factor resulting in the local loss of specialized woodland species (COPPINS and COPPINS, 2002; GROVE, 2002). Direct persecution, such as hunting and trapping, also frequently lead to the regional loss of specific woodland species, most notably large carnivores, birds and bats (FLOERICKE, 1927; EISENTRAUT, 1950; JANSSEN et al., 2013; SCHMIDT et al., 2016).

At the present time, ancient woodland sites with a long ecological continuity are regarded as especially valuable habitats and often stand out as biodiversity hotspots (NORDÉN et al., 2014; MEYER et al., 2015; STEFAŃSKA-KRZACZEK et al., 2016). This is particularly true for deciduous forests with over-mature oak and beech trees and large volumes of deadwood. Such stands, often former woodland pastures or woodland in inaccessible terrain and remote regions (RANIUS and JANSSON, 2000; HOLEKSA et al., 2009; RAPP and SCHMIDT, 2012, HORÁK et al., 2016), are frequently parts of protected areas (GLASER and HAUKE, 2004; VOLOŠČUK, 2014). Additionally, the European-wide Natura 2000 network is aimed at safeguarding and increasing the populations of certain woodland specialist beetles, birds and bats (THE COUNCIL OF THE EUROPEAN COMMUNITIES, 1992; THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EU, 2009). In general, efforts for nature conservation in European forests have been substantially increasing since the 1970s (AGNOLETTI, 2006). Conservation measures taken include the designation of strict forest reserves (PARVIAINEN et al., 2000; MEYER et al., 2007), retention forestry (FEDROWITZ et al., 2014), protection of habitat trees (NIEDERMANN-MEIER et al., 2010; BÜTLER et al., 2015), and endangered species conservation programs (e.g. for the black stork, *Ciconia nigra*; JANSSEN et al., 2013).

But even before the term ecological continuity was introduced and the importance of over-mature and veteran trees for biodiversity was widely recognized (LONSDALE, 2013; NORDÉN et al., 2014), there have been early approaches to protect veteran trees and deciduous woodland for other reasons. From the late 18th century onwards, a growing interest in nature, natural curiosities, and natural formations took place. This trend also led to a new perception of trees and forests. Picturesque veteran trees and scenic woodlands were increasingly considered to be "natural monuments" deserving protection (GILPIN, 1794; SCHMINKE, 1811; ANONYMUS, 1831; GÖPPERT, 1868; VRŠKA and HORT, 2008), and became political symbols for freedom and national identity. This development is closely linked to Sentimentalism, particularly to the work of FRIEDRICH GOTTLIEB KLOPSTOCK (1724–1803), and to Romanticism with poets like JOSEPH VON EICHENDORFF (1788–1857) and landscape painters such as CASPAR DAVID FRIEDRICH (1774–1840) (KÜSTER, 1998). This trend, however, can be also considered as a counter-movement to an increasingly rationalized forestry (SCHMOLL, 2004; SCHMIDT, 2012; SPANIER, 2015; MÖLDER, 2016). But also early forest scientists had advocated the protection of ancient trees and scenic woodland landscapes. KASPAR HEINRICH VON SIERSTORPFF (1750–1842) used the term "forest monument"

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(*Forstmonument*) as early as 1796 when referring to veteran oaks (SIERSTORPFF, 1796). In Schleswig-Holstein, AUGUST NIEMANN (1761–1832) stated in 1815 that veteran trees should be conserved as "venerable monuments". He also advocated the public announcement of the locations of veteran trees. Furthermore, NIEMANN militated against the conversion of deciduous woodlands into conifer forests, since this would change the "whole natural character" of a region. Rather, "oaks and beeches should be conserved as the most beautiful natural gift to the homeland" (NIEMANN, 1815). In the Kingdom of Hanover and later in the Kingdom of Saxony, EDMUND VON BERG (1800–1874) argued for maintaining deciduous woodland (BERG, 1834, 1844). He also initiated a systematic inventory of "remarkable trees" in the Saxon state forests in 1847. In the interests of science, it was deemed appropriate not only to describe the nature of these trees, but also to ensure the preservation of rare specimens (BERG et al., 1853). Comparable inventories have been conducted in the Grand Duchy of Hesse (WEDEKIND, 1838) and in the Kingdom of Hanover, where HEINRICH BURCKHARDT (1811–1879) was the initiator in 1858 (BRANDES, 1907).

As early as the late 18th century appeals and legal attempts were made to protect forest bird and bat species that were known to be natural enemies of arthropod pests both in deciduous and conifer forests. These utilitarian conservation efforts have to be seen in connection with large-scale insect calamities in coniferous forests at that time (WILDUNGEN, 1815; SCHMOLL, 2005; SCHMIDT et al., 2016). In 1819, KARL FRIEDRICH VON SPONECK (1762–1827) called for the preservation of old hollow trees for the purpose of protecting insectivorous birds and bats (SPONECK, 1819). Such trees became later known as "habitat trees" (BÜTLER et al., 2013). JULIUS THEODOR CHRISTIAN RATZEBURG (1801–1871) made similar recommendations (RATZEBURG, 1840, 1860). Both CONSTANTIN WILHELM LAMBERT GLOGER (1803–1863) and GUSTAV ERNST FRIEDRICH WIESE (1809–1887) complained about the lack of old forest trees and recommended the conservation of over-mature trees to provide food and nesting sites for woodpeckers and cave breeders (WIESE, 1859; GLOGER, 1865). Finally, the term "nature conservation" (*Naturschutz*) was coined by PHILIPP LEOPOLD MARTIN (1815–1885) in 1871 (HACHMANN and KOCH, 2015).

The question arises, whether these nature conservation ideas were received or implemented by forest managers at that time. In this study, therefore, we conduct a systematic review of the 19th century volumes of the oldest continuously publishing scientific forestry journal worldwide, the *Allgemeine Forst- und Jagdzeitung* (AFJZ). The AFJZ had been founded in 1825 and soon became an established journal, both for forest scientists and for practising forest managers (HASEL, 1979; STEINSIEK, 2004). By evaluating 75 years of journal and forestry history, this study aims at analyzing and discussing to what extent ideas and measures supporting ecological continuity and nature conservation have been implemented in 19th century forest management.

2. MATERIALS AND METHODS

2.1 The Allgemeine Forst- und Jagdzeitung (AFJZ)

The AFJZ was founded in 1825 and has been continuously published since then, with only a short interruption between 1944 and 1949 due to World War II (HASEL, 1979; STEINSIEK, 2004). By comparison, the still existing Polish scientific forestry journal *Sylwan*, although it was already established in 1820, was not published between

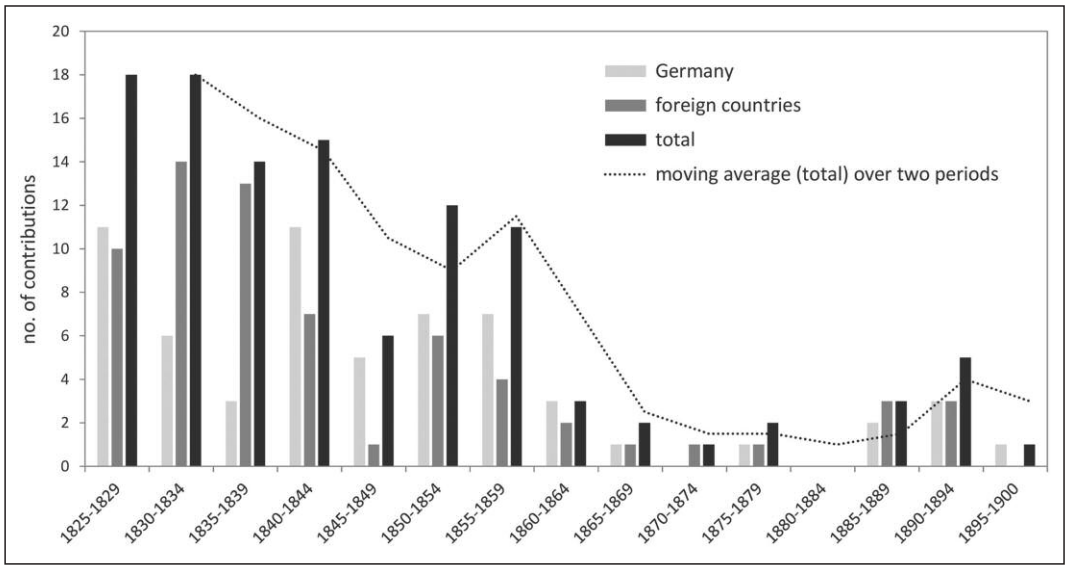

Fig. 1

Number of contributions on veteran trees in the AFJZ between 1825 and 1900. The data are pooled for five-year intervals.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit dem Thema „Baumveteranen" befassten. Die Daten wurden in 5-Jahres-Intervallen zusammengefasst.

1858 and 1883 (ZARZYŃSKI, 2001). Between 1825 and 1832, the AFJZ was published by W. L. Wesché's publishing house. Since 1832 it has been published by J. D. Sauerländer's Verlag. During the 19th century, the chief editors of the AFJZ were: 1825–1846 STEPHAN BEHLEN; 1847–1855 GEORG WILHELM FREIHERR VON WEDEKIND; 1856–1877 GUSTAV HEYER; and 1878–1901 TUISKO LOREY and JULIUS LEHR (until 1894) (HASEL, 1979; STEINSIEK, 2004). The volume numbering in the 19th century was as follows:

- 1825–1831: volumes 1–7 (old series; *Alte Folge, A.F.*)
- 1832–1844: volumes 1–13 (new series)
- 1845–1856: volumes 11–22 (repetition of volume numbers 11–13 in 1845–1847)
- 1857–1900: volumes 33–76 (volume number correction with 1825 as starting year)

2.2 Methods of literature review

All volumes of the AFJZ that were published between 1825 and 1900 have been systematically evaluated. This implied the review of both the annual tables of contents and the running text. Since many 19th century AFJZ volumes are available as pdf files in digital archives and repositories (DDB, 2016; HATHITRUST, 2016), in several cases full texts could be scanned using the Adobe Reader (ADOBE SYSTEMS, 2015) search tool. To answer the questions raised in the introduction, we focused on six main topics:

1. Appreciation of veteran trees
2. Appreciation of veteran oak trees
3. Protection of veteran trees
4. Protection of veteran oak trees
5. Protection of habitat trees
6. Protection of birds (incl. bats)

When conducting full-text scans, we searched for relevant key words such as "Baumveteran" (*veteran tree*), "Baumriese" (*giant tree*) and "merkwürdige Bäume" (*remarkable trees*) for veteran trees, "Höhlenbäume" (*hollow trees*) and "Spechtbäume" (*woodpecker trees*) for habitat trees, or "Singvögel" (*songbirds*), "Fledermäuse" (*bats*) and "Vogelschutzfrage" (*bird protection issue*) for bird and bat protection. If a full-text scan was not possible, the respective volumes were searched page by page. The same was done with printed AFJZ volumes if a pdf version was not available. In accordance with LONSDALE (2013), we used the term "veteran tree" to describe all trees that have pronounced characteristics of advanced aging, irrespective of chronological age. Ancient tree characteristics are 1) biological, aesthetic or cultural interest, because of great tree age, 2) a growth stage that is described as ancient or post-mature, and 3) a chronological age that is old relative to others of the same species (OWEN and ALDERMAN, 2008). Due to the high ecological importance of over-mature oaks, veteran oak trees (*Quercus* spp.) and their protection were examined as separate topics, too. The topic "protection of habitat trees" refers to the protection of trees for ecological reasons, e.g. the provision of roost and nesting sites for birds and bats. Since the protection of bats was frequently closely connected with the protection of birds (e.g., GLOGER, 1865), we brought birds and bats together in one group. Book and journal article reviews where considered when the reviewer expressed his own thoughts on relevant topics.

2.3 Bibliographic data processing

A total number of 215 relevant references was stored in a literature database and assigned to one or more of the six main topics. With regard to the topics 1-4, we dif-

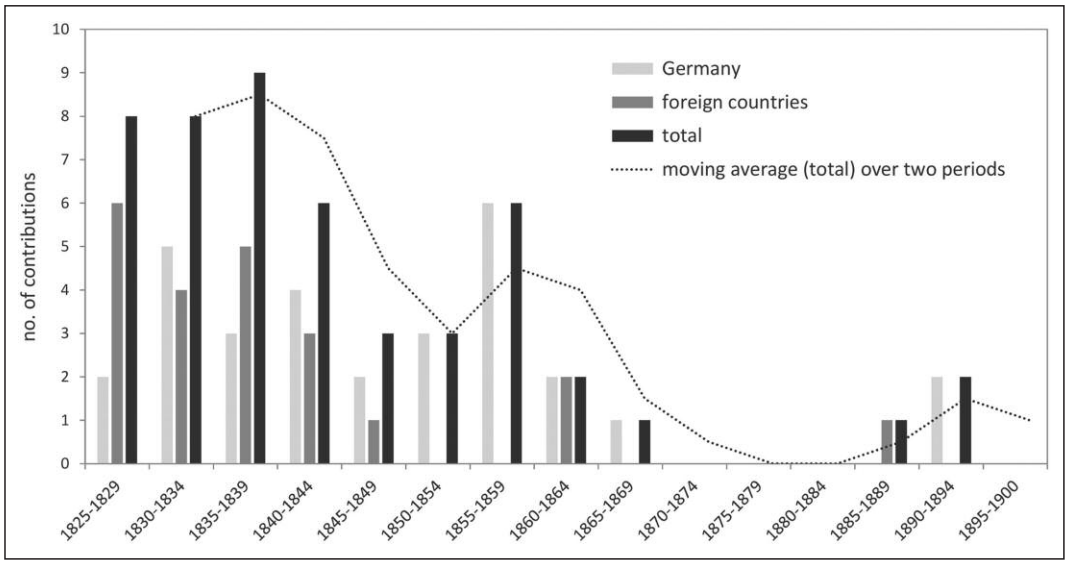

Fig. 2

Number of contributions on veteran oak trees in the AFJZ between 1825 and 1900. The data are pooled for five-year intervals.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit dem Thema „Eichenveteranen" befassten. Die Daten wurden in 5-Jahres-Intervallen zusammengefasst.

ferentiated between contributions (i.e., articles, letters, reports, book reviews) that were concerning Germany and such that dealt with foreign countries. In this study, we defined "Germany" as the area of the German Empire between 1871 and 1918, but excluding Alsace-Lorraine (*Reichsland Elsaß-Lothringen*) with its strong French background. Finally, the annual numbers of references were calculated for each topic.

2.4 Presentation of the results and discussion

In the results section, we present the changing relevance of the main topics during the investigation periods. To create illustrative bar diagrams, the annual numbers of references were pooled for five-year intervals. We then discuss the changing relevance of the main topics and point out particularly significant contributions in the AFJZ. This includes an analysis of the extent to which ideas and measures supporting nature conservation and ecological continuity were implemented in 19th century forest management. In doing this, we start with the discussion of the bird protection issue. After that, we discuss the historic appreciation and protection of veteran and habitat trees. Finally, the resulting implications and key factors for ecological continuity are depicted.

3. RESULTS

Reports and articles dealing with veteran trees were regularly published in the AFJZ between the 1820s and the 1850s, with a peak between 1825 and 1834 (*Fig. 1*). The three years with the highest number of contributions were 1831, 1843 (each with seven records) and 1828 (six records). From the 1860s onwards, relevant contributions were printed infrequently and remained totally absent in the first half of the 1880s. Between 1885 and the mid-1890s, a small increase occurred. During the whole investigation period, the contributions dealt with veteran trees both in Germany and in foreign countries. In the 1830s, reports on veteran trees in foreign countries outweighed the reports on German veteran trees.

With regard to veteran oak trees, the distribution patterns were generally similar (*Fig. 2*). The number of relevant contributions peaked in the second half of the 1830s. The years 1825, 1831 and 1836 showed the highest number of contributions (each with four records). In the 1850s, no reports on veteran oak trees in foreign countries were published, and between the 1870s and the mid-1880s contributions dealing with veteran oak trees were completely missing.

The protection of veteran trees is a topic that was mentioned mainly between the mid-1830s and the mid-1840s, and in the late-1850s (*Fig. 3*). Most contributions dealt with tree protection in Germany. A similar distribution pattern was found when looking at the protection of veteran oak trees (*Fig. 4*). However, the annual numbers of contributions on tree protection were low. With regard to the protection of veteran trees in general, three records were reached in 1843 and regarding the protection of veteran oak trees two records in 1893. The concept of habitat trees was firstly mentioned in the AFJZ in 1855. Until 1900, further seven contributions on this topic were published in 1860, 1865, 1866, 1872, 1894, 1897 and 1900.

Reports and articles on the protection of birds (incl. bats) were regularly printed throughout the whole inves-

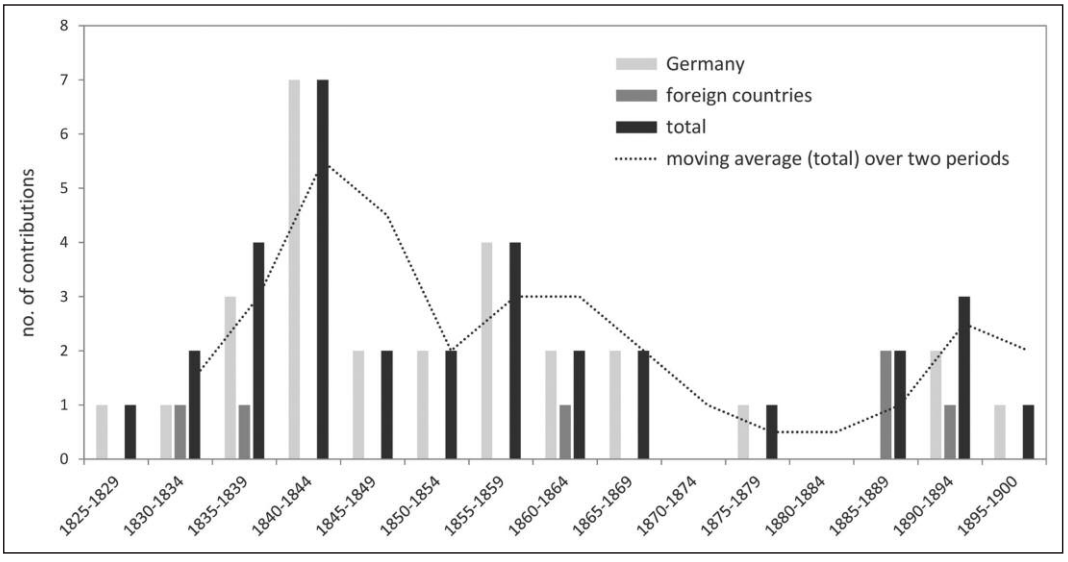

Fig. 3

Number of contributions on the protection of veteran trees in the AFJZ between 1825 and 1900. The data are pooled for five-year intervals.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit dem Thema „Schutz von Baumveteranen" befassten. Die Daten wurden in 5-Jahres-Intervallen zusammengefasst.

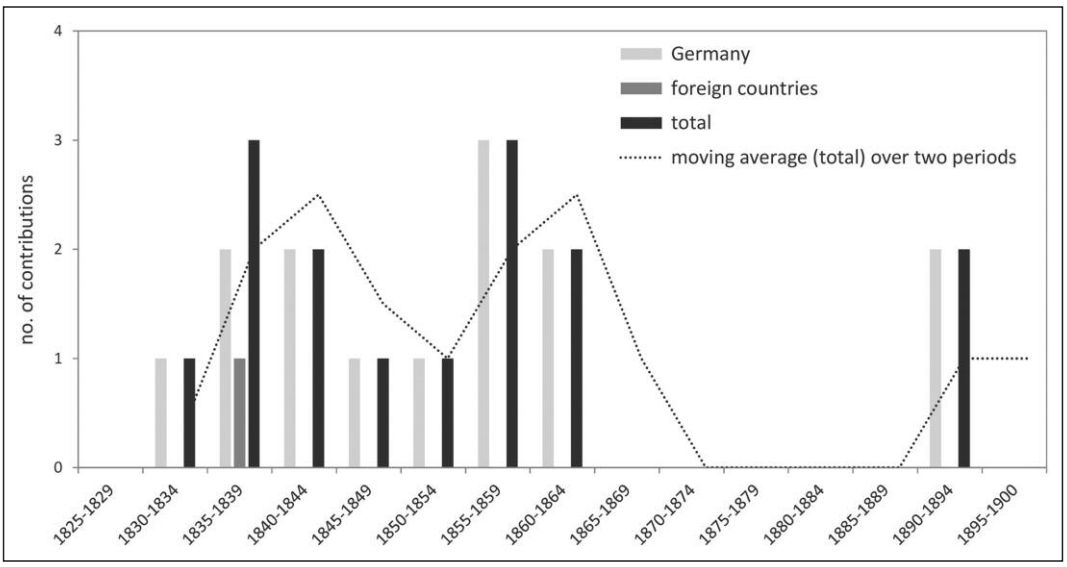

Fig. 4

Number of contributions on the protection of veteran oak trees in the AFJZ between 1825 and 1900. The data are pooled for five-year intervals.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit dem Thema „Schutz von Eichenveteranen“ befassten. Die Daten wurden in 5-Jahres-Intervallen zusammengefasst.

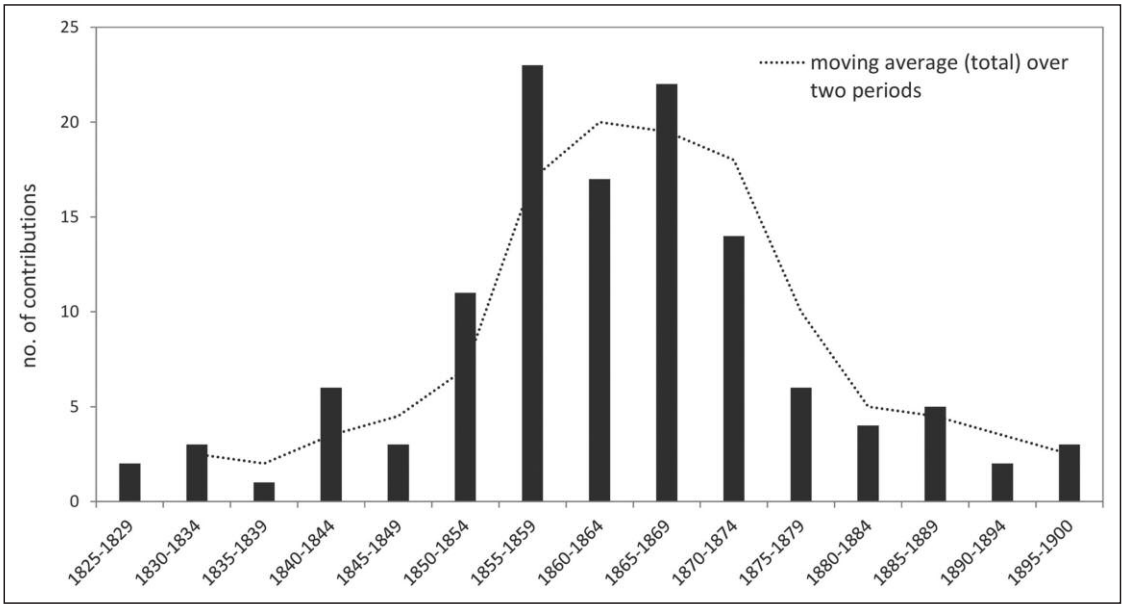

Fig. 5

Number of contributions on the protection of birds (incl. bats) in the AFJZ between 1825 and 1900. The data are pooled for five-year intervals.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit dem Thema „Schutz von Vögeln (inkl. Fledermäusen)“ befassten. Die Daten wurden in 5-Jahres-Intervallen zusammengefasst.

tigation period (*Fig. 5*). Most contributions were published in the middle of this time frame, between the years 1850 and 1874. The two years with the highest number of contributions were 1858 (9 records) and 1874 (7 records). Between 1862 and 1867, 4 contributions on the protection of birds were published in each year.

4. DISCUSSION

4.1 Bird protection

In 1888, the German national “Law Concerning the Protection of Birds” (*Gesetz, betreffend den Schutz von Vögeln*) was enacted (ANONYMUS, 1888; REICHSAMT DES INNERN, 1888), which can be regarded as a very impor-

tant step towards an effective bird protection throughout the country (SCHMOLL, 2005). This law, however, had a decades-long and often controversial history (RUSS, 1882; DEUTSCHER REICHSTAG, 1888; SCHMOLL, 2005) that is well reflected in the publication record of the AFJZ.

Generally, those contributions in the AFJZ that supported the protection of birds had a very utilitarian and anthropocentric focus. Only bird species deemed to be natural pest controllers were considered worthy of protection from hunting and persecution. As is shown below, however, the classification of single species as useful or harmful was often unclear and even controversial. This history can be traced back to the late 18th century, when the first efforts to protect insectivorous birds from persecution emerged after large-scale insect calamities in coniferous forests (SCHMOLL, 2005; SCHMIDT et al., 2016). Around 1800, renowned natural and forest scientists argued for the protection of insectivorous bird and bats, for instance JOHANN MATTHÄUS BECHSTEIN (1757–1822), GEORG AUGUST GOLDFUSS (1782–1848), JOHANN PHILIPP ACHILLES LEISLER (1772–1813) and LUDWIG VON WILDUNGEN (1754–1822) (GOLDFUSS, 1806; WILDUNGEN, 1815; BECHSTEIN, 1818; ALTUM, 1872; SCHMOLL, 2005). At this time, initial decrees on the protection of useful birds and bats were enacted in different German states (SCHMIDT et al., 2016).

When looking at the publication record of the AFJZ between 1825 and 1850, contributions giving attention to useful birds were released regularly, but not in large numbers. These contributions, however, covered a broad thematic spectrum. Besides articles highlighting the general importance of many birds as natural pest controllers (EIN WALDBESITZER IN SCHWEDISCH-POMMERN, 1828; OPIZ, 1831; KÖNIG, 1841; K., 1844) and criticizing migratory bird hunting in Italy (BALDENSTEIN, 1828), jurisdiction relating to the protection of useful birds and its effectiveness was critically evaluated (B* 1847). Additionally, the foundation of an association for the protection of songbirds in the Grand Duchy of Hesse was announced, with the AFJZ editor GEORG WILHELM VON WEDEKIND (1796–1856) as a leading member (ANONYMUS, 1843), and even two poems calling for the protection of forest birds were published (HOFFMANN, 1834; EIN JÄGER-GREIS IN KURLAND, 1846).

The 1850s saw a pronounced increase in contributions on birds, their usefulness and their protection. The driving force behind this development was the zoologist CONSTANTIN WILHELM LAMBERT GLOGER (1803–1863), who wrote 13 (38 %) of the 34 contributions on bird protection published between 1850 and 1859. GLOGER made observations about bird protection on a systematic basis and consistently lobbied for the protection of useful birds and their habitats on the governmental and land-user level (ANONYMUS, 1862; RUSS, 1882; QUANTZ, 1926; SCHMOLL, 2005). In the AFJZ, for instance, GLOGER published the articles "On the protection of owls" (*Zum Schutze der Eulen*; GLOGER, 1853b), "On the protection of buzzards" (*Zum Schutze der Bussarde*; GLOGER, 1854), "Protection for the cuckoo!" (*Schonung dem Kuckuke!*; GLOGER, 1855b) and "The main value of the woodpeckers" (*Der Hauptnutzen der Spechte*; GLOGER, 1855a). GLOGER, like other scientists, had recognized that the number of useful birds had been decreasing for several decades. Besides hunting, egg collecting and trapping (*Fig. 6*), the intensification of land use and the resulting loss of habitats were identified as the relevant causes (NAUMANN, 1849; GLOGER, 1853a, 1853c, 1865; WERNEBURG, 1869; MARTIN, 1873; BREHM, 1874; RUDORFF, 1880; RUSS, 1882). While GLOGER's proposals for the protection of habitat trees were mostly disregarded, or even rejected, by the AFJZ authorship (see section 4.3), his ideas on artificial roosts and nesting sites for bats and cave-breeding birds were successfully adopted and implemented by many forest managers (DIE REDAKTION DER

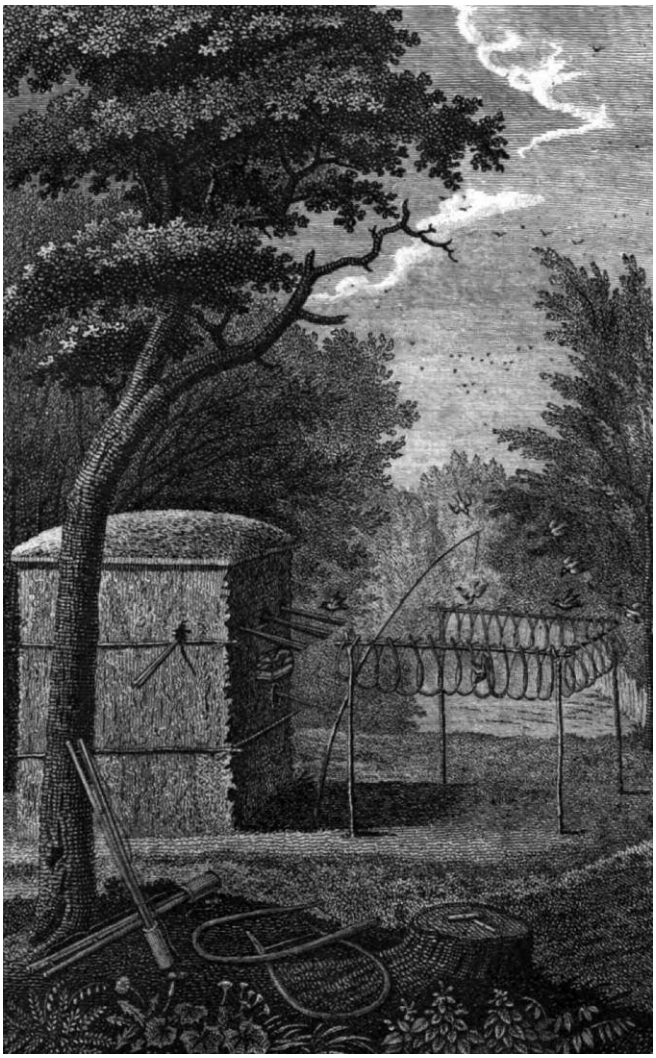

Fig. 6

Bird trapping site with different bird trapping techniques (e.g., springe-traps used for capturing tits) and a decoy bird in the cage mounted on the hut. Copper engraving "Der Meisentanz" by CARL FROSCH, reprinted from NAUMANN (1826).

Vogelherd (Fangplatz) mit verschiedenen Vogelfallen, z. B. Sprengeln (Schlingen) und Kloben (Klemmfallen) zum Meisenfang. An der Hütte befindet sich ein Käfig mit einem Lockvogel. Kupferstich „Der Meisentanz" von CARL FROSCH, abgebildet in NAUMANN (1826).

AFJZ, 1863; Anonymus, 1868b; Russ, 1882). This is also confirmed by periodical announcements in the AFJZ between 1864 and 1880 by a carpenter from Hesse, who manufactured nesting boxes according to Gloger's designs (e.g. Eller, 1864). In 1863, shortly before his death, Gloger was thankful for the "honorable implementation" of his nesting box ideas in the state forests of Hanover, where Burckhardt had started to raise funds for Gloger's work in 1863 (Die Redaktion der AFJZ, 1863). Already in 1862, the editorial board of the AFJZ made an appeal for funds to support Gloger's "charitable" and "self-sacrificing" endeavors (Anonymus, 1862). By the end of 1863, the sum of 795 thaler had been collected. Since Gloger had died on 30 December 1863, the donation was afterwards regarded as a reward for previous efforts (Die Redaktion der AFJZ, 1865). With regard to Prussia, however, Gloger criticized the lack of implementation of his ideas (Anonymus, 1862; Gloger, 1862), despite his publications on the protection of useful birds being widely spread among foresters and teachers by the government (Russ, 1882) and initial legal efforts for bird protection being made from 1860 onwards (Bureau des Ministeriums des Innern, 1860; Schmidt et al., 2016).

Between 1860 and the mid-1870s, the bird protection issue remained an intensively discussed topic, not only in the AFJZ, but also in other scientific and popular journals (Berg, 1869; Werneburg, 1869; Brehm, 1874; Russ, 1882). In the AFJZ, the influential forest scientists Franz von Baur (1830–1897), Richard Hess (1835–1916), Eduard Heyer (1819–1898) and Hans Ernst von Manteuffel (1799–1872) argued for the protection of useful birds (Baur, 1863; Heyer, 1865; Manteuffel, 1865; Anonymus, 1870). During this time, more and more German states enacted decrees on bird protection, and calls for nation- and even European-wide laws on bird protection were made (Anonymus, 1862, 1868a, 1870; Gloger, 1865; Leo, 1866; Berg, 1869; Deutscher Reichstag, 1888). To support this concern, enactments of bird protection decrees in France and Luxemburg in particular were pointed out in the AFJZ (– p – 1862; Gloger, 1863). The classification of several bird species as "useful" or "harmful", however, remained a central theme in the discussion for decades. This was particularly true for the common buzzard (*Buteo buteo*) (v. H., 1853; Gloger, 1854, 1857; Martin, 1854; Zimmer, 1900), sparrows (*Passer domesticus*, *P. montanus*) (Anonymus, 1870; Glaser, 1874) and woodpeckers (*Dendrocopos* spp., *Dryocopus martius*) (Gloger, 1855a; Wiese, 1860, 1874). The common raven (*Corvus corax*), the Eurasian eagle-owl (*Bubo bubo*) and most birds of prey were consistently classified as "harmful" (Martin, 1854; Snell, 1857, 1858b; Anonymus, 1870, 1888; Zimmer, 1900) and even the shooting of rare species like the merlin (*Falco columbarius*) was proudly reported (Rosshirt, 1880). Another controversial and hotly discussed issue in the AJFZ was the mass catching of thrushes, particularly fieldfares (*Turdus pilaris*), for food, which was perceived as being economically significant in many regions (Snell, 1858a; Einer für sehr Viele, 1869; Hartig, 1874; Beling, 1886; Anonymus, 1888).

From the late-1870s onwards, the political process enabling enactment of the German national "Law Concerning the Protection of Birds" in 1888 was operating (Russ, 1882; Anonymus, 1888; Deutscher Reichstag, 1888). As Schmoll (2005) stated, bird protectors hoped that the law could at least compensate for the habitat loss caused by modern land use schemes. Additionally, forest scientists had successfully put the bird protection issue on the agenda of the International Congress of Agriculture and Forestry in Vienna in 1873 (Anonymus, 1873; Hartig, 1874). These efforts finally resulted in the enactment of the International Convention for the Protection of Birds Useful to Agriculture in 1902 (Reichsamt des Innern, 1906; Korn et al., 1998; Schmoll, 2005). As a consequence of these achievements, the number of contributions on bird protection in the AFJZ again became infrequent (*Fig. 7*).

During the last three decades of the 19th century, the perception of birds shifted from a merely utilitarian to a nature conservation approach, giving rise to an influential social movement for bird protection (Russ, 1882; Schmoll, 2005; Hachmann and Koch, 2015). In going beyond utilitarian reasons for protecting birds, the 1888 national law was, as Schmoll (2005) highlighted, innovative for its time. In the preamble of this law it was stated that, in addition to the usefulness of birds, "the aesthetic and moral considerations upon which the endeavors established in the popular consciousness are based certainly deserve attention" (Deutscher Reichstag, 1888; Schmoll, 2005). In the Kingdom of Württemberg, were the idea of animal protection developed from the 1820s onwards in the milieu of the Württemberg Pietism, moral considerations for bird protection were particularly popular. Christian Adam Dann (1758–1837) and other Protestant pastors were pioneers of animal protection, and the first German animal protection association was founded in Stuttgart in 1837 (Schmoll, 2004; Jung, 2005; Ernst, 2011). This tradition was continued by nature conservation pioneers Philipp Leopold Martin and Lisa Hähnle (1851–1941), who founded the League for Bird Protection (*Bund für Vogelschutz*) in 1899 (Ernst, 2011; Hachmann and Koch, 2015). These moral and aesthetic considerations, however, were obviously more common among other middle-class intellectuals than among foresters. At least the publication record of the AFJZ leads to this assumption, since only Seitz (1892) and Anonymus (1889) emphasized non-utilitarian arguments for bird protection in this journal. Noteworthy, in this regard, is an elaborate article by the entomologist Adalbert Seitz (1860–1938), who, after critically discussing the usefulness of forest birds, stated that "as much as we appreciate the aesthetic significance of birds, – to prefer it to the useful significance seems dangerous" (Seitz, 1892).

In summary, it can be said that many 19th century foresters successfully promoted the protection of (useful) birds and were a driving force behind decrees on bird protection. The loss of bird habitats due to forest management intensification, however, continued during the 19th century and even increased towards the end of this period, as discussed in the following sections.

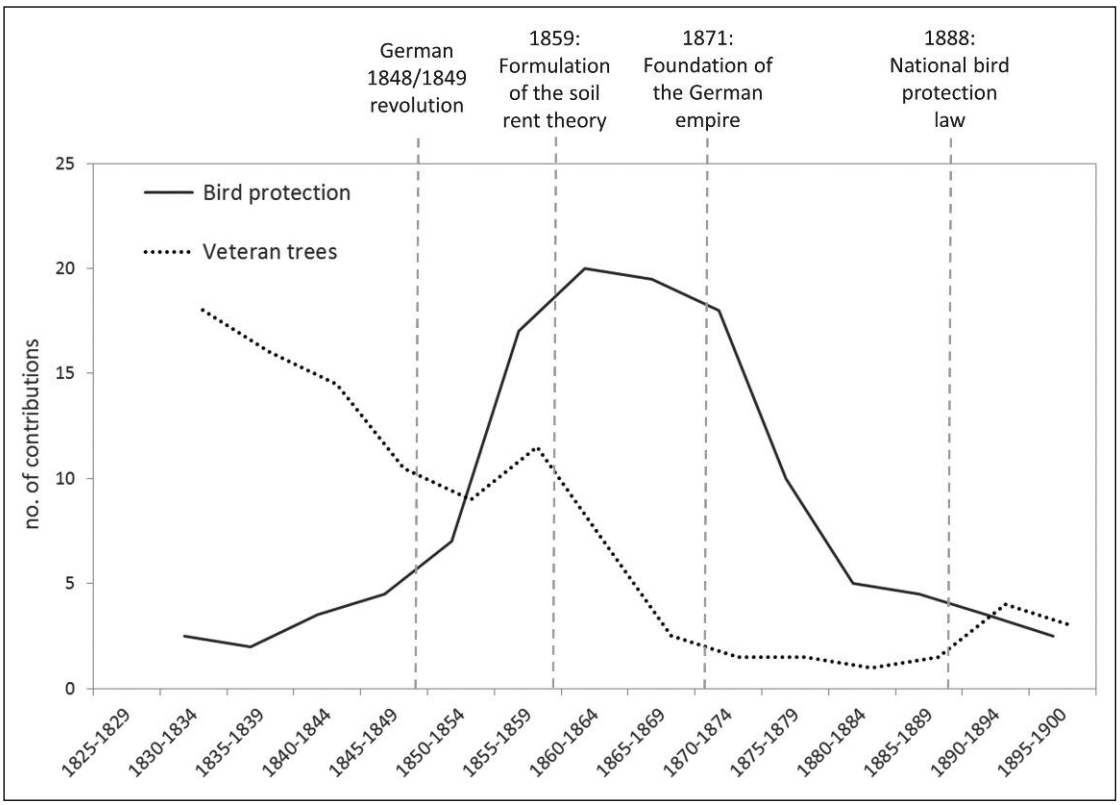

Fig. 7

Number of contributions on veteran trees and bird protection in the AFJZ between 1825 and 1900 and relevant historical events. The two curves correspond to the "moving average (total) over two periods" curves in *Fig. 1* and *Fig. 5*.

Anzahl der Beiträge in der AFJZ, die sich zwischen 1825 und 1900 mit den Themen „Baumveteranen" und „Vogelschutz" befassten, ergänzt um maßgebliche geschichtliche Ereignisse. Die beiden Kurven entsprechen den gleitenden Mitteln in den *Abb. 1* und *5*.

4.2 Appreciation and protection of veteran trees

Several books and articles, particularly those written by NIEMANN (1809, 1815), PFEIL (1833), VON WEDEKIND (1838), VON BERG et al. (1853) and MIELCK (1863), refer to the fact that there was great interest in remarkable veteran trees in the early and mid-19th century Germany. This trend is reflected by the results of the present study (*Fig. 7*). Between the 1820s and the 1850s, many reports on veteran trees were published in the AFJZ. During the second half of the 1840s, the report number was lower, which can be attributed to the German 1848/1849 revolution and the surrounding circumstances. As STEINSIEK (2004) states, the AFJZ volumes between 1847 and 1848 are marked by the social and political changes and their causes. However, although reports on veteran trees had been a regular topic in the AFJZ until the end of the 1850s, they became rare from that time on until the late 1880s, when a small increase occurred (*Fig. 7*). This development can be seen in the light of changing attitudes towards Romantic-aesthetic ideas among foresters that came along with the rise of two contradictory schools of forest economics. While early 19th century foresters and forest scientists like NIEMANN and VON WILDUNGEN often had a tendency to Romantic ideas (ZIMMERMANN, 1990; MÖLDER, 2016) and the same is true for BURCKHARDT some years later (BURCKHARDT, 1866; SCHMOLL, 2004), many of their mid- and late 19th colleagues were not susceptive to this mentality (BEYREUTHER, 1882; HÖLZL, 2010). This is particularly true for the supporters of the soil rent theory (*Bodenreinertragslehre*), which had been developed by MAX PRESSLER (1815–1886) in the late 1850s (PRESSLER, 1858; PRESSLER, 1859) and was refined and applied in practice in the following years (BEYREUTHER, 1882; JUDEICH, 1887; WINKELBAUR, 1887). Based on the formula of MARTIN FAUSTMANN (1822–1876) and previous intellectual progresses (FAUSTMANN, 1849; VIITALA, 2016), the soil rent theory aimed at maximizing the net interest on land, timber capital, and silvicultural investments by optimizing rotation periods and cultivated tree species. Following the soil rent theory, even-aged coniferous forests with relatively short rotation periods proved to be most advantageous (HOPKINSON, 1913; PERRY, 1998; MÖHRING, 2001). PRESSLER's publications sparked a long-lasting and highly controversial debate among the supporters of the soil rent theory (e.g., G. HEYER, M. FAUST-

MANN, G. KRAFT) and the advocates of the alternative forest rent theorie (*Waldreinertragslehre*; e.g., F. VON BAUR, B. BORGGREVE, H. BURCKHARDT) in Germany (HASEL, 1979; MÖHRING, 2001). The forest rent theory, on which the Prussian concept of forest management was based, meant that the forests had to be managed for the highest total surplus without taking any interest into account (HOPKINSON, 1913; MÖHRING, 2001). Generally, in forest stands that were efficiently managed for high yields, neither veteran trees nor hollow trees could be tolerated because they reduced the revenues of the land owner (MARTIN, 1873; MARTIN, 1882; HOPKINSON, 1913). Already in 1841, WILHELM PFEIL (1783–1859) summarized the development towards a more efficient forest management in his essay "The poetry of the forest" (*Die Poesie des Waldes*) with an ironic undertone (PFEIL, 1841): "No profession had to sacrifice more of life's poetry than the foresters."

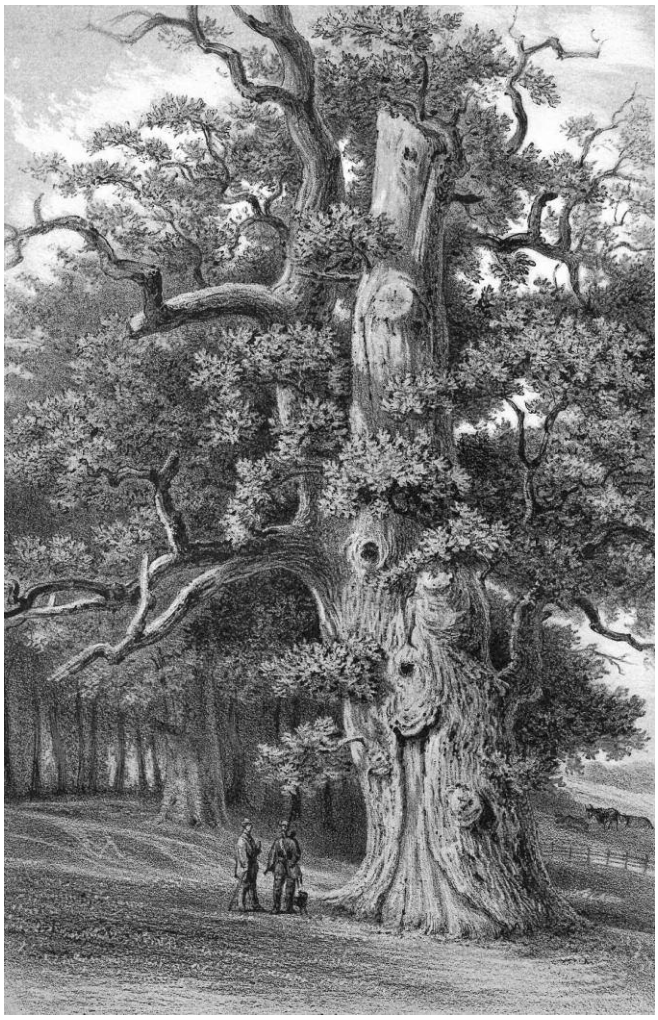

Fig. 8

Oak in the Salzau deer preserve in Holstein. Lithograph, reprinted from MIELCK (1863).

Eiche im Thiergarten zu Salzau in Holstein. Lithographie, abgebildet in MIELCK (1863).

In this context, the decrease in reports on veteran trees in the AFJZ can also be linked to the change of editorship from VON WEDEKIND to GUSTAV HEYER (1826–1883) in 1856. While VON WEDEKIND had an interest in old trees and their preservation (WEDEKIND, 1838), HEYER's main field of research was forest economics. He and one of his successors, TUISKO LOREY (1845–1901), editor of the AFJZ between 1880 and 1901, were supporters of the soil rent theory (HESS, 1905; STEINSIEK, 2004).

Another reason for the decreasing number of reports on veteran trees is the fact that remarkable trees became increasingly rare in the mid-19th century due to modern land use practices (NIEMANN, 1809; KOCH, 1843; MARTIN, 1873; TREBSDORF, 1887). After the abolition of servitudes (usage rights), particularly old oak trees growing in pasture woodlands were felled and replaced by agricultural fields or stands with a higher tree and timber quality (BURCKHARDT, 1879; RUDORFF, 1880; BÜTLER et al., 2013; MÖLDER et al., 2014). Already in 1815, NIEMANN regretted this development (NIEMANN, 1815). In the AFJZ, several reports on ancient trees described the felling procedures or bewailed the end of the veterans (PERNITZSCH, 1826; KL., 1828; ANONYMUS, 1831a, 1868c; TREBSDORF, 1887). In 1843, KOCH stated that reports on remarkable trees were a regular topic in older forestry journals. Present times, however, "with their special circumstances and management conditions, make new reports on exceptionally big trees more and more rare" (KOCH, 1843).

Articles on the theme of veteran trees and appeals for their preservation were also published in the AFJZ (ST., 1828; FRÜHLING, 1831; MÜLLER, 1835; KÖNIG, 1841; KOCH, 1843; SEIDENSTICKER, 1844; GLOGER, 1855a; PÜSCHEL, 1855; DENGLER, 1856; SNELL, 1859; WALDECK, 1860). Veteran oak trees (*Fig. 8*), in particular, were considered in this regard (FRÜHLING, 1831; SEIDENSTICKER, 1844; PÜSCHEL, 1855; SNELL, 1859; WALDECK, 1860). One remarkable document is the paper "Words for the conservation of forests and trees" (*Worte für die Erhaltung der Wälder und Bäume*), which GOTTLOB KÖNIG (1779–1849) read in 1840 at the Meeting of German Agriculturalists and Foresters in Brünn (KÖNIG, 1841). When arguing for a more cautious forest management, KÖNIG noted: "But above all, we want, as far as possible, to conserve and maintain the giant stands and trees from earlier times that still exist here and there. (…) The forester of the future may incidentally use them to compare nature's silviculture favorably with our narrow-minded forestry arts." LEOPOLD DENGLER (1812–1866) also raised this topic and exhorted his forester colleagues to treat remarkable trees cautiously (DENGLER, 1856). KOCH, head forester in a large private woodland estate in northern Thuringia, gave examples of the conservation of ancient trees in his district (KOCH, 1843). He highlighted that the forest owners had decided to conserve several ancient oaks and beeches for the future. Additionally, he desired that old trees should be protected "as venerable witnesses of past centuries" in other forests as well. Such trees would also be defenders against the accusation that his times "would only appre-

ciate material interests and would only strive for acquisition and profit."

In 1885, HEINRICH VON SALISCH (1846–1920) published his influential book "Forest Aesthetics" (*Forstästhetik*), which probably stimulated the small increase of AFJZ reports on veteran trees in the following years. SALISCH's interpretation of forest aesthetics, however, was rooted in forest economic interests. Although he included a chapter "On the beautification of forest stands by maintaining time-honored trees" (*Verschönerung der Wald-Bestände durch Pflege altehrwürdiger Bäume*) in his book, he advocated the felling of dispensable over-mature oaks. And while he supported the conservation of single remarkable tree veterans, he highlighted that a high number of over-mature and decaying oaks "is not an ornament for the forest" (SALISCH, 1885). WILBRAND (1893) even argued that "an over-mature forest in a state of die-back, with dry crown tops and fungi growing on the trunks, is not beautiful. A decay-stage forest, with decaying logs, makes an embarrassing impression."

Although systematic inventories of remarkable trees had already been compiled in the Grand Duchy of Hesse (WEDEKIND, 1838) and in the Kingdoms of Hanover (ANONYMUS, 1858; MIELCK, 1863) and Saxony (BERG et al., 1853), a comparable listing was missing in Prussia for a long time, despite some initial efforts in the 1850s (VIEBAHN and SCHUBARTH, 1856). This knowledge gap was filled from 1900 onwards due to the efforts of ALFRED JENTZSCH (1850–1925) and HUGO CONWENTZ (1855–1922), who became the director of the Prussian Central Institute for the Care of Natural Monuments in 1906 (FISCHBACH, 1900; JENTZSCH, 1900; CONWENTZ, 1914; SCHMOLL, 2004). CONWENTZ and JENTZSCH implemented ideas that were raised in the AFJZ under the title "Tree vandalism – A proposal for its future prevention" (*Baum-Vandalismus – Vorschlag zur künftigen Verhinderung desselben*) in 1868 (ANONYMUS, 1868c): "Public authorities care for the conservation of old (...) buildings and interesting ruins. The natural monuments of our homeland deserve the same protection. As a basis for this, an official register of all relevant trees (…) would be very useful." Between 1900 and 1907, systematic inventories of veteran trees and other botanical peculiarities were compiled for six Prussian provinces (*Forstbotanische Merkbücher*; CONWENTZ, 1900; SCHLIECKMANN, 1904; RÖRIG, 1905; WINKELMANN, 1905; HEERING, 1906; BRANDES, 1907). In southern Germany, comparable inventories were made in the Grand Duchy of Baden and in die Kingdoms of Bavaria and Württemberg (KLEIN, 1908; SCHMOLL, 2004). Several veteran trees, however, really underwent the same conservation methods as old buildings. WILBRAND (1893) described how rotten trunks of old oak and lime trees were closed with masonry "according to a proven method" in Hesse.

4.3 Protection of habitat trees

For nature conservation history, 19th century accounts of the protection of over-mature trees for ecological reasons are particularly important. These contributions show that the concept of "habitat trees" is considerably older than generally assumed (BÜTLER et al., 2013). The initial protection efforts were, however, mostly utilitarian. They are, though, early examples of appreciation of the ecosystem services of over-mature trees (*Fig. 9*). While in present times dead- and decaying wood is regarded as important for carbon sequestration and saproxylic biodiversity (LACHAT et al., 2013), in the 19th century over-mature trees were valued for providing roosts and nesting holes for insectivorous bats and birds (SPONECK, 1819; BREHM and ROSSMÄSSLER, 1864; ANONYMUS, 1865; GLOGER, 1865; ALTUM, 1872; MARTIN, 1882, 1884) (*Fig. 8*). In this regard, BREHM and ROSSMÄSSLER (1864) referred to decaying trees as "fortifications in the forest, by which it is guarded and protected". For this reason, "it seems inevitably necessary to omit trees with heart rot during logging and to let them decay."

With regard to the publication record of the AFJZ, contributions on the protection of over-mature trees for ecological reasons are sparse, but significant. Thus, in articles on the usefulness of woodpeckers for forestry, GLOGER and WIESE argued for the deliberate protection of habitat trees (GLOGER, 1855a; WIESE, 1860). ZIMMER (1900) made similar demands concerning the conservation of hollow trees for owls. At the First Conference of German Foresters, held 1872 in Brunswick, the ornithologist and professor for natural sciences BERNARD ALTUM (1824–1900) held a talk and recommended that hollow trees be left in forests as nesting sites for birds (ANONYMUS, 1872). There were also practicing foresters who spoke out for the conservation of habitat trees, for instance HÄFNER (1866), who was district forester in a private forest in Franconia. OSTERHELD, chief forester in the Bienwald (southern Palatinate), made this confession (OSTERHELD, 1897): "Already as a young forester and friend of the birds, I always aimed at omitting several sick trees with entrance holes during thinnings, and I often tried to humbug my supervisor for this purpose." OSTERHELD emphasized that his subordinates knew that, wherever possible, woodpecker trees should be preserved.

The prevailing procedure, however, was to eliminate potential habitat trees from the forest. CARL WILHELM JULIUS GIESELER, former head forester in Syke in Hanover, reported in 1894 that already in the 1830s he was advised to remove all hollow trees from old oak stands. This treatment prevailed even in the 1890s. In his last years, GIESELER reviewed the issue critically, after observing a decades-long decline in the number of useful birds. He finally recommended maintaining old hollow trees, particularly oaks, to protect insectivorous birds (GIESELER, 1894).

Very revealing is the review of GLOGER's book "The conservation of cavity breeders" (*Die Hegung der Höhlenbrüter*) from 1865, in which he demanded (ANONYMUS, 1865; GLOGER, 1865): "All German governments should command their forest officers (and supervise strictly) that no hollow trees, which are suitable for cavity breeders, are cut down." Moreover, GLOGER claimed that trees should be planted at suitable places, which can serve as hollow trees in the future. The anonymus reviewer in the AFJZ, obviously a forester, spoke out vigorously against GLOGER's postulations (ANONYMUS, 1865): "No

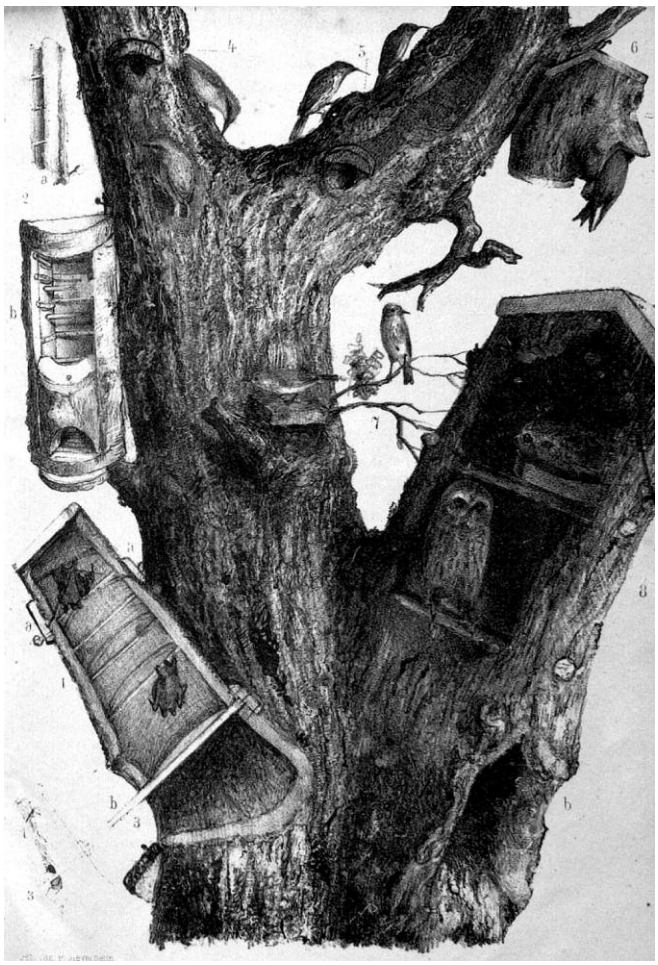

Fig. 9

Old hollow oak, equipped with different artificial roosting and nesting facilities for birds and bats. Pictured animals: Bats (Microchiroptera), owls (Strigiformes), flycatchers (Muscicapidae), treecreepers (*Certhia* sp.), common swift (*Apus apus*), Eurasian nuthatch (*Sitta europaea*). Lithograph by PAUL MEYERHEIM, reprinted from GLOGER (1865).

Höhlenreiche Alteiche, ausgestattet mit verschiedenen Schlaf- und Brutkästen für Vögel und Fledermäuse. Abgebildete Tiere: Fledermäuse (Microchiroptera), Eulen (Strigiformes), Fliegenfänger (Muscicapidae), Baumläufer (*Certhia* sp.), Mauersegler (*Apus apus*), Kleiber (*Sitta europaea*). Lithographie von PAUL MEYERHEIM, abgebildet in GLOGER (1865).

efficient forester will, where the wood has an acceptable price, let trees decay to create living space for cavity breeders." Instead, nesting boxes should be used. The reviewer hoped that no government would heed GLOGER's advice, since this would severely harm the interests of the forest owners.

4.4 Implications for ecological continuity

It is, however, a difficult task to assess the long-lasting impacts of those 19th century forest scientists and managers who called for the preservation of veteran and habitat trees. The conservation of over-mature trees and tree stands, particularly wood pastures with old oaks, could be also the result of forest management for hunting purposes, long-persisting servitudes or very conservative management in private forests (BURCKHARDT, 1879; KARLSCH, 1991; BEHRENS, 1998; BHU, 2012; MÖLDER et al., 2014). Landscape painters also successfully influenced the conservation of veteran trees and the designation of early ancient tree reserves (GILPIN, 1794; ANONYMUS, 1831b). This was the case in the forest districts "Neuenburger Urwald" and "Hasbruch" near Oldenburg in the 1870s, and in the Sababurg wood pasture in the Hessian Reinhardswald in 1907 (FOCKE, 1871; POTT and HÜPPE, 1992; RAPP and SCHMIDT, 2012). To give another example, descriptions made by SALISCH (1885) illustrate that foresters in Silesia have intentionally conserved many old and decaying oaks for such reasons, a practice that he criticizes: "In view of this practice, the foresters and forest owners are not so much guided by their own aesthetic judgment, but primarily by the continued influence, which poets and painters (…) and the associated public opinion have on us. Yes, there are several forest districts, where not a single older oak is felled; it may be as over-mature as it can be." With regard to the Eilenriede, a forest district owned by the city of Hanover, GUSTAV KRAFT (1823–1898) mentioned that many over-mature oak and beech trees were conserved against forestry principles because the inhabitants of Hanover had another opinion (KRAFT, 1893).

But, since influential supporters of veteran tree conservation, such as NIEMANN, BURCKHARDT and VON BERG (NIEMANN, 1815; MIELCK, 1863; BURCKHARDT, 1870), were also lecturers at different forest academies, their messages were received by many young foresters. The same is true regarding supporters of the habitat tree concept such as VON SPONECK, RATZEBURG and ALTUM (SPONECK, 1819; RATZEBURG, 1840; ALTUM, 1872; ANONYMUS, 1872). It is, therefore, probable that several still existing populations of specialized saproxylic species owe their survival to the efforts of these forest scientists. The publication record of the AFJZ, however, does not reflect this assumption clearly and, in addition, "tidy" forest management was instilled in young foresters for decades (HÄFNER, 1866; BEYREUTHER, 1882; GIESELER, 1894). It is reasonable to assume that cautious foresters maintained old and decaying veteran or habitat trees on the quiet, without informing the public, since such practice was contrary to instructions and ran against the forestry zeitgeist of the late 19th century. A very remarkable example for clandestine tree protection is the woodpecker tree protection described by OSTERHELD (1897). MARTIN (1884) mentioned that even initial efforts for the conservation of hollow trees in Prussia (since the 1860s; see BERNHARDT, 1869) and Württemberg had increased the number of cave breeders such as black- and other woodpeckers. Additionally, over-mature and decaying trees were regionally retained in cautiously managed private woodlands, for example in Schleswig-Holstein (*Fig. 7*), Mecklenburg or Thuringia (NIEMANN, 1809; ST., 1828; KOCH, 1843; ROHNERT, 1866; MÖLDER et al., 2014). In neighboring Bohemia, forest reserves were established in large private woodland estates as early as 1838 (VRŠKA and HORT, 2008).

The main trend during the 19th century, however, was efficient and economical forest management with a strong orientation towards tidy woodland, conifers and short rotation periods (Häfner, 1866; Brehm, 1874; Beyreuther, 1882; Gieseler, 1894; Endres, 1898; Hopkinson, 1913; Hölzl, 2010). The ecological and deadwood continuity that had persisted for centuries in many woodlands was, therefore, widely interrupted in this time period (Grove, 2002; Bütler et al., 2013; Mölder et al., 2014). As a consequence, several specialized saproxylic species vanished (Grove, 2002; Meyer et al., 2015). The conservation of solitary tree veterans or small stands of ancient trees can hardly secure populations of specialized saproxylic species in the long-term. These populations are frequently "ghosts of the past" (Ohsawa, 2007; Buse, 2012). As a consequence, those stands with long-term ecological continuity and vital populations that have persisted until present times, deserve careful management and protection. Special concepts are essential to preserve these hotspots of biodiversity and to maintain the ecological continuity for the future. For instance, sufficient future habitat trees have to be supported in the surroundings of over-mature and decaying oak stands (Bütler et al., 2013; Nordén et al., 2014). With special regard to oak forests, the current research project QuerCon (i.e., *Quercus* Continuity) aims to develop solutions for forest and nature conservation management that sustain the ecological value of oak forests without significantly affecting the economic viability of oak silviculture (Mölder et al., 2016).

5. CONCLUSIONS

By reviewing the AFJZ volumes published between 1825 and 1900, it could be shown that early ideas and measures supporting ecological continuity and nature conservation were regularly discussed. The central topics were the appreciation and protection of veteran trees, and the protection of habitat trees and birds. Both the temporal emphasis and the practical implementation of the different topics, however, varied considerably. While contributions dealing with veteran trees and their protection were most notably published between the 1820s and the 1850s, bird protection was a hot topic between the 1850s and the mid-1870s. The idea of habitat trees was occasionally mentioned between 1855 and 1900.

Although systematic inventories of veteran trees were compiled in several Germans states and some trees were protected, general legal instructions for veteran tree protection were not enacted in the 19th century. The latter is also true for the concept of habitat tree protection, which was already known in the second half of the 19th century, at least to more educated foresters. Despite sporadic conservation efforts, rationalized and tidy forest management resulted in extensive losses of over-mature trees and, thereby, in a widespread disruption of ecological continuity. In Germany, however, the first systematic conservation network of forest nature reserves and natural monuments was established in Prussia from 1906 onwards by the Central Institute for the Care of Natural Monuments (Bock, 1910; Conwentz, 1914). After World War II, the nation-wide designation of strict forest reserves began in the mid-1950s in the German Democratic Republic, and in the early 1970s in the Federal Republic of Germany (Kluttig, 2007; Meyer et al., 2007). Systematic schemes for the protection of habitat trees were introduced in the 1970s (Stein, 1978; Jedicke, 1995).

When looking at the history of bird protection, the situation appears to be different. The legal protection of useful birds, which was primarily seen as an economic issue, was heavily lobbied by influential forest scientists. Their political efforts were directed towards both national and international bird protection. After the successful implementation of national legislation on bird protection in the 1880s, the interest in the protection of birds faded among forest scientists. New nature conservation ideas, which went beyond utilitarian reasons for protecting birds, were more common among other middle-class intellectuals than among foresters. The loss of bird habitats due to forest management intensification, however, continued during the whole of the 19th century.

6. ABSTRACT

In Central Europe, ancient woodland sites with a long ecological continuity are regarded as especially valuable habitats and often stand out as biodiversity hotspots. This is particularly true for deciduous forests with overmature oak (*Quercus robur*, *Q. petraea*) and beech (*Fagus sylvatica*) trees, which are frequently parts of protected areas. But even before the term ecological continuity was introduced and the importance of overmature trees for biodiversity was widely recognized, there have been early 19th century approaches to protect veteran trees and deciduous woodland for aesthetical and historical reasons. With regard to forest birds and bats, already around 1800 utilitarian conservation efforts were made to protect species that were known to be natural enemies of arthropod pests. Already in those days forest scientists called for the preservation of old hollow trees for the purpose of protecting insectivorous birds and bats. Such trees became later known as habitat trees.

The question arises, whether these early nature conservation ideas have been received or implemented by forest managers at that time. We therefore conducted a systematic review of the 19th century volumes (1825–1900) of the oldest continuously published scientific forestry journal worldwide, the Allgemeine Forst- und Jagdzeitung (AFJZ). By evaluating 75 years of journal and forestry history, this study aimed at analyzing and discussing to what extent ideas and measures supporting ecological continuity and nature conservation were implemented in 19th century forest management.

By reviewing the 19th century AFJZ volumes, it could be shown that the central topics appreciation and protection of veteran trees, and the protection of habitat trees and birds were regularly discussed. Both the temporal emphasis and the practical implementation of the different topics, however, varied considerably. While contributions dealing with veteran trees and their protection were most notably published between the 1820s and the 1850s, bird protection was a hot topic between the 1850s

and the mid-1870s. The concept of habitat trees was occasionally mentioned between 1855 and 1900.

Although systematic inventories of veteran trees were compiled in several Germans states and some trees were protected, general legal instructions for veteran tree protection were not enacted in the 19th century. The same is also true for the concept of habitat tree protection, which was known to foresters from journals and books already in the second half of the 19th century. Despite sporadic conservation efforts, rationalized forest management resulted in extensive losses of over-mature trees and, thereby, in a widespread disruption of ecological continuity. In Germany, however, the first systematic conservation network of forest nature reserves and natural monuments was established in Prussia from 1906 onwards.

When looking at the perceived history of bird protection, the situation appears to be different. The legal protection of useful birds, which was primarily seen as an economic issue, was heavily lobbied by influential forest scientists. Their political efforts were directed towards both national and international bird protection. After the successful implementation of national legislation on bird protection in the 1880s, interest in the protection of birds faded among forest scientists. New nature conservation ideas, which went beyond utilitarian reasons for protecting birds, were more common among other middle-class intellectuals than among foresters. The loss of bird habitats due to forest management intensification, however, continued during the whole 19th century.

7. ZUSAMMENFASSUNG

Titel des Beitrages: *Forstwirtschaft, Habitatkontinuität und Vogelschutz im Deutschland des 19. Jahrhunderts: Eine systematische Literaturauswertung.*

Waldstandorte mit einer langen Habitatkontinuität werden in Mitteleuropa als besonders wertvolle Lebensräume angesehen und sind häufig Hotspots der biologischen Vielfalt. Dies gilt insbesondere für Laubwälder mit alten Eichen (*Quercus robur*, *Q. petraea*) und Buchen (*Fagus sylvatica*), die vielfach Bestandteile von Schutzgebieten sind. Aber noch bevor der Begriff der Habitatkontinuität geprägt wurde und die Bedeutung alter Bäume für die biologische Vielfalt allgemein anerkannt war, gab es zum Beginn des 19. Jahrhunderts von forstlicher Seite Ansätze, Baumveteranen und Laubwaldbestände aus ästhetischen und historischen Gründen zu schützen. Im Hinblick auf waldbewohnende Vögel und Fledermäuse wurden bereits um 1800 utilitaristische Schutzanstrengungen unternommen, um solche Arten zu schützen, die als natürliche Feinde von Schadinsekten galten. Darüber hinaus sprachen sich bereits in jener Zeit Forstwissenschaftler für die Erhaltung von alten, oft höhlenreichen Bäumen mit dem Ziel aus, insektenfressende Vögel und Fledermäuse zu fördern. Solche Bäume bezeichnet man heute als Habitatbäume.

Um die Frage zu klären, ob diese frühen Naturschutzideen von den damaligen Förstern wahrgenommen oder sogar umgesetzt worden sind, haben wir eine systematische Durchsicht der im 19. Jahrhundert publizierten Bände (1825–1900) der Allgemeinen Forst- und Jagdzeitung (AFJZ) vorgenommen. Die AFJZ ist die älteste kontinuierlich herausgegebene forstwissenschaftliche Fachzeitschrift der Welt. Mit dieser Auswertung zielte die Studie darauf ab, zu analysieren und zu diskutieren, in welchem Umfang Ideen und Maßnahmen zur Förderung von Habitatkontinuität und Naturschutz in der Waldbewirtschaftung des 19. Jahrhunderts umgesetzt wurden.

Es konnte gezeigt werden, dass in den AFJZ-Ausgaben des 19. Jahrhunderts die Wertschätzung und die Bewahrung von Baumveteranen sowie der Schutz von Habitatbäumen und Vögeln regelmäßig erörterte Themen waren. Sowohl die zeitlichen Schwerpunkte als auch der Erfolg von praktischen Maßnahmen erwiesen sich hinsichtlich der verschiedenen Themenbereiche jedoch als sehr unterschiedlich. Während Beiträge zu Baumveteranen und zu deren Schutz vor allem zwischen den 1820er- und den 1850er-Jahren veröffentlicht wurden, war der Vogelschutz zwischen den 1850er-Jahren und der Mitte der 1870er-Jahre ein wichtiges Thema. Die Habitatbaum-Idee fand zwischen 1855 und 1900 gelegentliche Erwähnung.

Obwohl in mehreren deutschen Staaten systematische Inventuren von bemerkenswerten alten Bäumen durchgeführt und einige Bäume geschützt wurden, gab es im 19. Jahrhundert keine allgemeingültigen rechtlichen Vorschriften für den Schutz von Baumveteranen. Das Letztere galt auch für das Konzept des Habitatbaumschutzes, das den Förstern bereits in der zweiten Hälfte des 19. Jahrhunderts aus Fachzeitschriften bekannt war. Trotz gelegentlicher Schutzbemühungen führte eine zunehmend rationalisierte Waldbewirtschaftung zu umfangreichen Verlusten an sehr alten Bäumen und damit zu einer weitreichenden Unterbrechung der Habitatkontinuität. In Deutschland wurde das erste Netz von Waldnaturschutzgebieten und Naturdenkmälern ab 1906 in Preußen aufgebaut.

Hinsichtlich der Umsetzung der Vogelschutzidee stellten sich die Verhältnisse gänzlich anders dar. Der rechtliche Schutz von nützlichen Vögeln, der in erster Linie als eine wirtschaftlich bedeutsame Angelegenheit angesehen wurde, fand die Unterstützung von einflussreichen Forstwissenschaftlern. Deren politische Bemühungen waren auf einen nationalen und internationalen Vogelschutz ausgerichtet. Nach dem Inkrafttreten von nationalen Rechtsvorschriften zum Vogelschutz in den 1880er Jahren ließ das Interesse der Forstwissenschaftler am Schutz der Vögel jedoch nach. Neue Naturschutzideen, die über den Schutz von Vögeln aus utilitaristischen Gründen hinausgingen, fanden vor allem in nicht-forstlich geprägten Teilen des Bürgertums großen Anklang. Der Verlust von Vogellebensräumen aufgrund einer Intensivierung der Waldbewirtschaftung setzte sich jedoch während des gesamten 19. Jahrhunderts fort.

8. RÉSUMÉ

Titre de l'article: *Gestion forestière, continuité écologique et protection des oiseaux au 19ème siècle en Allemagne: une revue systématique de la littérature.*

Les stations forestières comprenant une longue continuité d'habitats sont considérées en Europe centrale comme des biotopes particulièrement précieux et sont souvent des zones actives de la diversité biologique. Ceci est valable particulièrement pour les forêts feuillues avec de vieux chênes (*Quercus robur*, *Q. petraea*) et des hêtres (*Fagus sylvatica*) qui sont pour beaucoup des parties de peuplements de zones mises en réserves. Mais avant que le terme de continuité des habitats n'ait été imprimé dans les esprits et que la signification des vieux arbres pour la diversité biologique n'ait été reconnue de manière générale, il y eut, au début du 19ème siècle, des démarches de la part des forestiers pour protéger des arbres vétérans et des peuplements feuillus pour leurs caractères esthétiques et historiques. Eu égard aux populations d'oiseaux et de chauves-souris inféodés aux forêts, 1800 mesures pratiques de protection ont été prises pour protéger ces espèces qui sont des prédateurs naturels des insectes nuisibles. De plus, des scientifiques forestiers se sont exprimés en leur temps pour le maintien de vieux arbres souvent riches en cavités avec l'objectif de favoriser les oiseaux et chauves-souris prédateurs d'insectes. De tels arbres sont désignés aujourd'hui comme arbres-habitats.

Pour clarifier la question si ces idées précoces de protection de la nature ont été perçues par les forestiers de l'époque ou même ont été mises en application, nous avons réalisé une recherche systématique dans les publications de la revue *Allgemeine Forst- und Jagdzeitung* (AFJZ) de 1825 à 1900. La revue AFJZ est la plus ancienne parution en sciences forestières dans le monde, qui fut éditée de manière continue. Avec cette exploitation de données, l'étude a ciblé d'analyser et de discuter avec quelle étendue les idées et mesures ont été mises en pratiques pour favoriser la continuité des habitats et la protection de la nature dans la gestion forestière du 19ème siècle.

Il a pu être mis en évidence que, dans les numéros de l'AFJZ du 19ème siècle, l'évaluation et la conservation des arbres vétérans tout comme la protection des arbres-habitats et des oiseaux étaient des thèmes régulièrement abordés. Tant les points ponctuels essentiels qu'également la réussite de mesures pratiques se sont avérés être très diversifiés par rapport aux différents thèmes. Pendant que des contributions ont été publiées sur les arbres vétérans et sur leur protection entre les années 1820 et 1850, la protection des oiseaux a été un thème important entre les années 1850 et le milieu des années 1870. L'idée des arbres-habitats a été citée occasionnellement entre 1855 et 1900.

Bien que dans de nombreux länder allemands des inventaires systématiques de vieux arbres remarquables aient été réalisés et quelques arbres protégés, il n'y eut, durant le 19ème siècle, aucune disposition juridique valide de manière générale, visant à protéger les arbres vétérans. La plus récente s'appliqua aussi au concept de protection des abres-habitats qui a été porté à la connaissance des forestiers dans les revues techniques durant la deuxième moitié du 19ème siècle. Malgré les efforts de protection au cas par cas, une gestion forestière évoluant vers une rationalisation accrue a conduit à des pertes importantes de très vieux arbres et avec cela à une interruption trop large de la continuité des habitats. En Allemagne, le premier réseau de zones forestières naturelles en protection et en réserves intégrales naturelles, a été installé à partir de 1906 en Prusse.

Par rapport à la mise en œuvre de l'idée de protection des oiseaux, les comportements se sont présentés totalement différemment. La protection juridique des oiseaux à caractère utile, qui furent considérés prioritairement pour leur rôle économique, a trouvé le soutien de scientifiques forestiers influents. Leurs efforts politiques ont été orientés sur la protection des oiseaux à la fois nationale et à la fois internationale. Après l'entrée en vigueur des directives légales pour la protection des oiseaux dans les années 1880, l'intérêt des scientifiques forestiers pour la protection des oiseaux s'est cependant relâché. De nouvelles idées de protection de la nature qui dépassent les aspects utilitaires de la protection des oiseaux, ont trouvé un écho en grande partie principalement auprès des non-forestiers. Mais la perte d'espaces de vie pour les oiseaux, en raison de l'intensification de la gestion forestière, s'est poursuivie durant l'ensemble du 19ème siècle.

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Untersuchungen zu Langzeiteffekten der Ausbringung von Rinden-Aschen-Presslingen auf Sickerwasser- und Bodenchemie sowie ernährungskundliche Effekte in einem Fichtenaltbestand im Oberpfälzer Wald

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(Mit 9 Abbildungen und 5 Tabellen)

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SCHLAGWÖRTER – KEY WORDS

Fichtenbestand; Rinden-Asche-Presslinge; Düngung; Sickerwasserchemie; Nährstoffnachhaltigkeit; Ernährungszustand; Biomasse; Bodenchemie.

Spruce stand; bark ash pellets; fertilization; seepage water chemistry; nutrient sustainability; nutritional state; biomass; soil chemistry.

1. EINLEITUNG

Da jede Holznutzung einen Nährstoffexport darstellt, kann dies zu unausgeglichenen Nährstoffbilanzen führen. In einem natürlichen Waldökosystem entnimmt der aufstockende Bestand die für das Wachstum notwendigen Nährelemente dem Boden und gibt diese durch den Zerfall der Bestandesglieder wieder in den Kreislauf zurück. In bewirtschafteten Ökosystemen fehlt für die entnommene Biomasse dieser letzte Schritt. Nach wie vor ist das Interesse an Holz als CO_2-neutralem Energieträger hoch. Nach aktuellen Zahlen des Statistischen Bundesamtes stieg der Anteil des Energieholzes am Gesamteinschlag in Deutschland von 8,3 Mio. Festmeter ohne Rinde im Jahr 2006 auf 11 Mio. Festmeter ohne Rinde im Jahr 2015. Dies entspricht einem Anteil von ca. 20 % am Gesamteinschlag (STATISTISCHES BUNDESAMT, 2015). Um den Bedarf an Energieholz zu decken, werden heute auch zunehmend schwächere Sortimente und Kronenmaterial stärker genutzt. Aus ernährungskundlicher Sicht ist diese Entwicklung kritisch einzuschätzen, da sich in diesen Kompartimenten die höchsten Nährelementgehalte befinden und mit deren Nutzung der Nährstoffexport im Vergleich zur Biomassemehrausbeute überproportional steigt (GÖTTLEIN und ETTL, 2009; ETTL und GÖTTLEIN, 2007; KÖLLING und BORCHERT, 2013; MEIWES et al., 2013). Neben der energetischen Nutzung des Kronenmaterials und somit dem vollständigen Entzug aus dem Ökosystem kommt es aus Gründen des Bodenschutzes durch das üblicherweise Ablegen des

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