



What Did the Cultural Landscape on Bornholm Look Like in the Mid-Eighteenth Century? An Analysis of Hammer's Map

Ulrich Walz¹ 

Received: 22 October 2023 / Accepted: 25 January 2024
© The Author(s) 2024

Abstract

The island of Bornholm, located in the Baltic Sea, has undergone a strong landscape change over the last 250 years, which has had an impact on the landscape form and functions (agriculture, recreation, biodiversity). In this paper, Hammer's historical map series from the 1750s is processed and evaluated using GIS technology. The results are presented and mapped according to the individual land use types and cultural landscape elements. For example, 250 years ago there was a very large proportion of extensively used heathland and very little forest, which is exactly the opposite today. In addition, there were a large number of smaller landscape elements, which together made for a diversely structured, agriculturally used landscape. This also includes the many smaller standing waters as well as wetlands and bogs. The large number of defensive installations recorded, such as redoubts, batteries, forts and signal points, clearly shows the military importance of the map and the significance of such installations for the security of the island at that time. The high number of windmills and water mills, the agricultural farms and the churches were also recorded. The resulting maps, which are also available digitally and interactively to the public, show the significant landscape change, which is placed in a historical context and discussed with its current effects, e.g. on biodiversity.

Keywords Landscape transformation · Landscape change · Cultural landscape elements · Biodiversity · Historical maps · Landscape analysis

Wie sah die Kulturlandschaft Bornholms Mitte des 18. Jahrhunderts aus? Eine Analyse der Karte von Bernhard F. Hammer

Zusammenfassung

Die in der Ostsee gelegene Insel Bornholm unterlag in den letzten 250 Jahren einem starken Landschaftswandel, der Auswirkungen auf die Landschaftsgestalt und die Funktionen (Landwirtschaft, Erholung, Biodiversität) hatte. In diesem Beitrag wird das historische Kartenwerk von Hammer aus den 1750er-Jahren mit GIS-Technologie aufbereitet und ausgewertet. Die Ergebnisse werden nach den einzelnen Landnutzungstypen und Kulturlandschaftselementen vorgestellt und kartographisch dargestellt. So gab es vor 250 Jahren einen sehr großen Anteil von extensiv genutzten Heideflächen und nur wenig Wald, was heute genau umgekehrt ist. Dazu kamen ein Vielzahl von kleineren Landschaftselementen, die zusammen für eine vielfältig strukturierte, agrarisch genutzte Landschaft sorgte. Dazu gehören auch die vielen kleineren Stillgewässer sowie Feuchtflächen und Moore. Deutlich wird aufgrund der Vielzahl der verzeichneten Verteidigungsanlagen, wie Schanzen, Batterien, Festungen und Signalpunkte auch die militärische Bedeutung des Kartenwerks sowie die Bedeutung solcher Anlagen für die Sicherheit der Insel zur damaligen Zeit. Erfasst wurden u.a. auch die hohe Zahl der Wind- und Wassermühlen, der landwirtschaftlichen Höfe und die Kirchen. Die Ergebniskarten, die auch digital interaktiv für die Öffentlichkeit verfügbar sind, zeigen den

✉ Ulrich Walz
ulrich.walz@htw-dresden.de

¹ Dresden University of Applied Sciences (HTW Dresden),
Pillnitzer Platz 2, 01326 Dresden, Germany

starken Landschaftswandel, der in den historischen Kontext gestellt und mit seinen heutigen Auswirkungen, z.B. auf die Biodiversität diskutiert wird.

1 Introduction

The Danish Baltic Sea island of Bornholm is probably known to many as a holiday island. Due to its somewhat remote location, the island has so far been largely spared from mass tourism, although it has a great variety of landscapes. The northern part is predominantly characterised by the rocky coastline and the southern part by wide, sometimes very fine sandy beaches with pronounced dune areas. There are large forests on the island, which also have a high recreational value. Lakes, marshes and bogs as well as areas of heathland enrich the diversity of ecosystems. In addition, there are attractive coastal villages and culturally historical testimonies such as round churches and prehistoric burial mounds. All of this is very attractive to holidaymakers.

At the same time, large parts of the island are also used for (intensive) agriculture. Furthermore, many traces of the mining of raw materials such as granite or coal can be found.

As interesting as this landscape may seem today, it is also recognizable in many places that it has undergone a strong transformation over the last 200 years. This becomes clear, for example, when one looks at one of the first cartographic surveys of the country, the map by Bernhard Franz Hammer, which he took in the years 1746–1750.

In this article, therefore, it will be presented how, according to Hammer's land survey, the landscape of Bornholm might have looked like. Central questions are:

- Which landscape elements (natural and cultural) can be identified in Hammer's map?
- What were the main land uses and what was the structure of the landscape?
- How can this historical state of the landscape be characterised in comparison to today?

For this purpose, the map was analysed with a geographic information system (ArcGIS Pro from ESRI), which makes the spatial comparison with current data and a statistical analysis possible in the first place.

The historical state of the landscape is compared with the literature on landscape utilisation at that time and placed in relation to developments up to the present day. Current literature is used to discuss the effects on today's uses and functions of the landscape.

2 Basics

2.1 Hammer's Map

The first true-to-life accurate map of Bornholm was produced between 1746 and 1752, called "Accurate Aftegnelse over Öen Bornholm".¹ On 15 October 1745, Bernhard Frantz Hammer was ordered to Bornholm to produce two precise maps of Bornholm.

On 13 March 1752, Commander von Schepeler wrote to his superiors in Copenhagen that he had received the two maps, as well as an additional one. One of the maps was sent to the king to be used when he should "command the country". A second map was to remain on Bornholm and be available to the commander and county officials. This is the copy that can be seen today in the Bornholm Museum in Rønne.

The King's copy is now in the Royal Library in Copenhagen (see Fig. 1). This map has been digitised and is available online as a scan,² and a black and white copy is printed in Brandt (1958).

The maps of the Bornholm Museum and the Royal Library are very similar. Both show the boundaries of the individual fields and the extent of the commons (Danish "Udmark") outside the actual agricultural areas (see Fig. 1).

In the winter of 1796, Hammer's map was copied by Lieutenant Joh. Heinrich du Plat. The vignette reveals that it was copied from a third map (called the "Grund-Tægning"), which was more detailed than the two known "original" maps. Another copy drawn by Mr. Krag, but only of a section around Hammershus/Sandvig, is in the map collection of the Queen's reference library³. The map by du Plat is the best preserved. It is now in the Danish National Archives and is also available online.⁴ It is very clear due to the redrawing and differs from the other two in that the houses in the towns are marked with gardens and streets. The boundaries of the individual arable plots are not included, but otherwise they are very similar to the two older maps (Fig. 2). A grid with a mesh size of 1/8 Danish mile (corresponds to approx. 941.5 m) is superimposed on the map series. The scale is approx. 1:17,000. The evaluations in this paper refer to this map series in the following.

¹ The following account of the history of Hammer's map is based on: <https://www.bornholmerting.dk/bibliotek-bornholms-historie/hammers-kort-over-bornholm/>.

² For information on the source, see Fig. 1.

³ see: <https://www.kongernessamling.dk/de/dronningens-haandbibliotek/> "Carte over den nordligste Deel af Bornholm grundet paa det af Hammer 1750 opmaalte Carte og Situationen oculair indtegnet i Junij Maanet 1796 / af Krag".

⁴ For information on the source, see Fig. 2.



Fig. 1 Copy of Hammer's map in the Royal Library of Denmark. Source: Det Kongelige Bibliotek, "Accurate aeftegnelse over Öen Bornholm beliggende i Öster-söen og incorporeret med Siällands Stift under Kongeriget Dannemark", Hammer, Bernhardt Franz 1750.

For the question of what the landscape looked like around 1750, it is important to know which land use classes are recorded. In the copy by Joh. Heinrich du Plat, a small legend is attached that includes a few land uses. These include meadows, woodland, scrub as well as heathland. The coastal areas are depicted in great detail and various different coastal forms are distinguished. In the map itself, further land uses can be clearly assigned/interpreted (see Table 1, further symbols also in the following chapters). These include swamps/marshes, wet meadows and sandy areas with dunes. Furthermore, an extensive network of paths and watercourses is marked, although both are not differentiated in their significance. Settlements are depicted with indicated courtyard areas/gardens. In particular, agricultural farmsteads are depicted, including the numbering still valid today.

Open access, https://soeg.kb.dk/discovery/search?query=any,contains,KBK%201111,26-0-1750~2F1a-1&tab=Everything&search_scope=MyInst_and_CI&sortby=date_d&vid=45KBDK_KGL:KGL&facet=frbgroupid,include,1860553481320296&offset=0

2.2 Preparation of the Map with a Geographical Information System

The individual map sheets of the du Plat copy can be downloaded online from the National Archives. These are 25 individual square sections of the map. In the first step, these were put together in the Geographical Information System (GIS) into a previously constructed regular grid to form a mosaic. This resulted in an overall map that was not yet referenced, but which fits together very well at the intersections of the partial maps. The resulting area-wide map was then in the second step georeferenced, i.e. identical points in more recent maps already provided with coordinate systems were assigned. These can still be clearly identifiable objects such as churches, prominent terrain points, agricultural farms or similar. The newer maps used include the Ordnance Survey sheets 1842–1899 from the Danish Survey Administration, which are closest in time to Hammer's map.

Almost 400 control points were set. The "Spline" method was used for transformation, which uses triangular meshing



Fig. 2 Copy of Hammer's map by du Plat. The cut-out shows a part of the mosaicked map sheets (see text). Source: Rigsarkivet—Danish National Archive, Kort over Bornholm, 1746, Flickr (<https://www.flickr.com/photos/statensarkiver/albums/72157677324664522>), CC BY-SA 2.0 ()

to ensure that identified points are regarded as fixed and that no equalisation calculation is carried out over the entire map. In this way, local distortions can be better compensated for than using a 2nd or 3rd-order equalisation calculation.

Good results were also achieved with these methods in similar projects (Walz and Berger 2003). Reference was made to the currently valid coordinate system ETRS 1989 UTM Zone 33N (EPSG 25833). Control measurements on the current topographical map at a scale of 1:25,000 from the Danish National Survey showed deviations in position of 0 to approx. 30 m in the settlement area and a maximum of 120 m in areas of open countryside far from settlements. These values are within the usual range for the scale and the time of origin of the map.

The result was a georeferenced map that could be integrated into the GIS and overlaid with other geodata. This forms the basis for the subsequent digitisation of landscape elements.

2.3 Further Geoservices


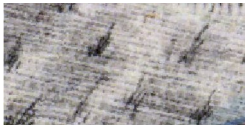
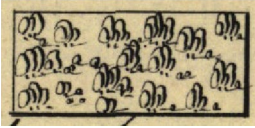

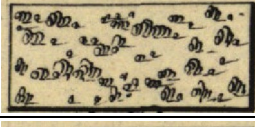
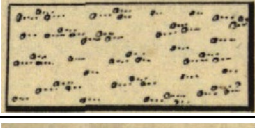







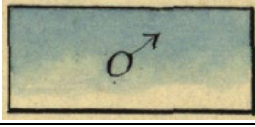
A whole range of publicly available geoservices could be used as additional information. The following services are worth mentioning:

- "Historiske Kort" / Historical Maps".⁵ In addition to current data such as cadastral maps, aerial photographs and topographic maps, this service also contains historical maps, for example, the first register map of Bornholm.
- The "datafordeler" / data distributor,⁶ through which, in contrast to the previous service, topographic data can be integrated directly into a GIS via wms or wcs ser-

⁵ <https://drift.kortinfo.net/Map.aspx?Page=Historiskekort&Site=Bornholm>

⁶ <https://datafordeler.dk/>.

Table 1 Land uses and land covers of Hammer's map resp. the copy of du Plat. Source: Screenshots of selected uses of Hammer's map or from the legend. Source: See Fig. 2

		Others not mentioned in legend	
	Meadow („Eng“)		Swamp, fen (near Wallens Kier)
	Wood, Forest („Skov“)		(near Snoegebaek)
	Scrub („Kratt“)		
	Heather or common land („Lyng eller Udmarken“)		Wet meadow (east of Arnager)
	Gravel stones („Klinder Steene“)		Wetland (between Arnager and Rønne)
	Rocks rising out of the water („udaf vandet opstaaende Klipper“)		Sand, sand dunes (near Dueodde)
	Skerries or rocks under water („Skiær eller Klipper under Vandet“)		Settlement with houses, streets, open spaces and gardens
	Pure sandy soil („reen sandbund“)		

vices. An example of this are the planimetric map sheets 1842–1899.

- “Historical Maps”⁷ is part of Styrelsen for Dataforsyning og Infrastruktur. It is more of a catalogue where historical maps can be searched and downloaded, but not geo-referenced.
- „Historiske kort pa nettet”⁸/Historical maps online of the „Geodatytrelsen“ (Board of geodata). The original register maps can also be downloaded there.

⁷ <https://historiskekort.dk/>.

⁸ <https://hkpn.gst.dk/>.

The register map is the oldest nationwide cadastral map. The 94 map sheets of Bornholm were surveyed in a first pass in the period 1784–1818 and drawn at a scale of 1:4,000. From 1852 onwards, the map was replaced by a second mapping run. The individual map sheets can be viewed at hkpn.gst.dk.

3 Results

In the following, individual topics will be addressed, and the objects recognisable in the map will be presented and analysed statistically and cartographically. As far as possible, literature on the historical status and development of

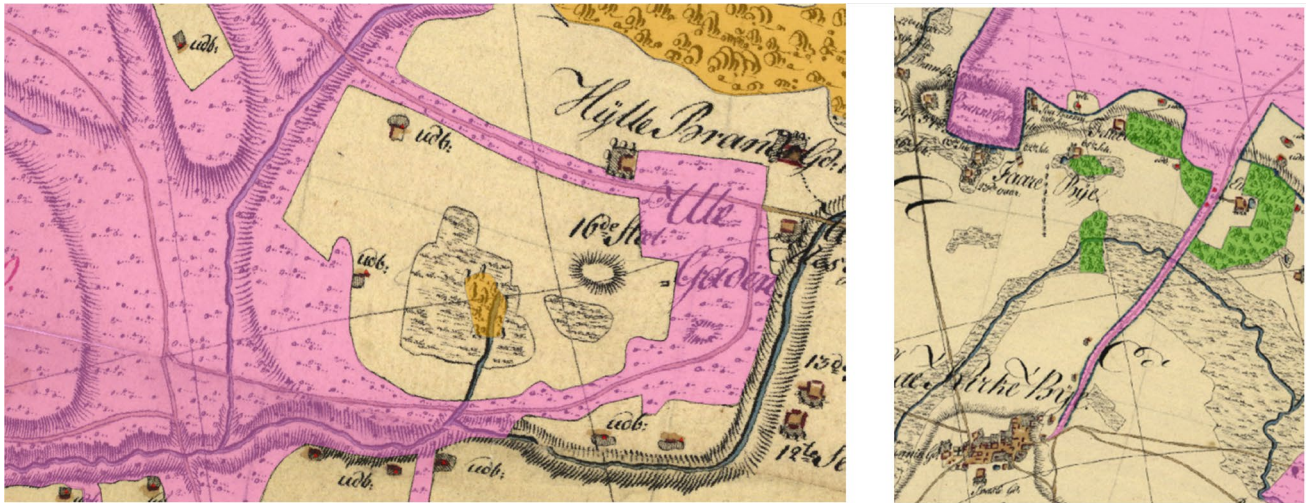


Fig. 3 Drift alleys "Gade" leading to the Udmark. On the left west of Nylars and on the right at Aakirkeby. See Fig. 4 for legend. Source of Basemap: See Fig. 2, own colouring

the individual subject areas to date was also consulted and discussed. This includes the following topics in particular:

- Common land, heaths and forests
- Settlement, especially agricultural farms
- Wind and water mills
- Cultural monuments such as castles, churches
- Fortifications and defence works

3.1 Common Land, Heaths and Forests

Around 1750, at the time of Hammer's land survey, the island was much more bare and open than it is today (Fig. 4). Forests and wooded areas accounted for only about 9% of the area. Groves are mostly understood here as areas loosely covered with lower and higher shrubbery (see Table 1 "Kratt / Shrub"). Forests are mostly limited to the slopes of valleys and other smaller areas between agricultural areas.

In contrast, heath and other low vegetation occupied 26% of the island's area. This was the so-called "Udmark", i.e. land outside the farmers' actual agricultural areas. The Udmark belonged to the king but could be used by the general public, in the classical sense of the German word "Allmende" (= common land). This is also referred to by the name Almindingen (= Allmende) for the large area in the centre of the island (Blüthgen 1975: p. 202). "Since time immemorial the inhabitants of Bornholm have had the right to use the hinterland of the island, which they use partly as common pasture for livestock (horses, cattle, sheep, pigs and geese) and partly for raking heath, cutting peat and harvesting shallow peat." (Olsen 1920: p. 83). It was precisely these uses that led to heavy grazing, so that these areas were largely free of woods. Today, remnants of these heathland

areas have only been preserved in small areas and are maintained by today's nature conservation authorities. They can only give a small impression of Bornholm's once completely different character.

Between the farms and the common land of the Udmark, there were sometimes drift roads along which the cattle could be driven from the farms to the pasture land. Today, these are still reflected in some places in the street names with "gade" (Hansen 2013: p. 279), such as the drift road from Aakirkeby to the north, which is still called Bygaden today (Fig. 3 right). At another place west of Nylars, the name Gade is entered directly in Hammer's map (Fig. 3 left).

In their 1815 geographical description of Bornholm in the year 1815, Rawert and Garlieb (1819: p. 251) wrote: "The forests on Bornholm are divided into royal and private. [...] besides these, there are here and there in the countryside small pieces of forest and individual trees; but they are not of any importance, and one hardly knows how to designate them properly. The private forests form the largest forest stock in the country; they do not lie together, but are divided into small forest groves in which several landowners have a share."

The low proportion of forest led to a shortage of timber, which was reflected in the way the houses were built. Thus Blüthgen (1975: S. 206) writes: "The timber frame had been standardised in town and country since the Middle Ages. This was necessary to save wood, because the forests of the island, which is now so densely wooded, were completely devastated in the Middle Ages by felling, slash-and-burn and forest grazing, and did not yield enough timber."

Today, the percentage distribution of forest and heath is completely different. According to official statistics

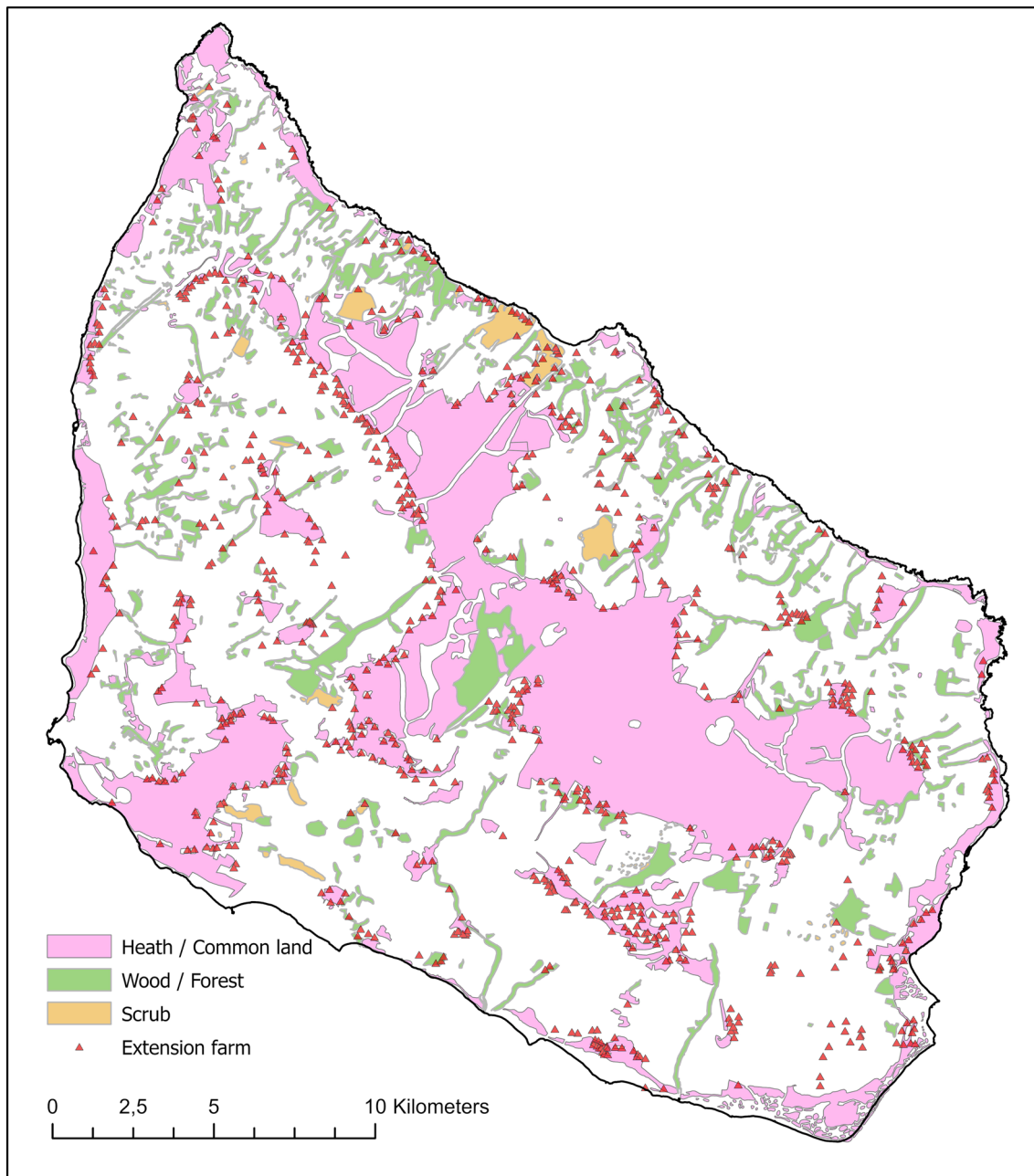


Fig. 4 Forest and heathland with the location of the extension farms on Bornholm. Editing and Cartography: Walz

(Danmarks Statistik⁹), the share of forest on Bornholm in 2021 was approx. 21% (cf. approx. 1750 9%) and the share of near-natural, dry habitats such as heath and dunes approx. 3% (cf. heath areas / commons approx. 1750 26%). However, dunes are not included in the figure of 26% heath areas around 1750. Today, therefore, an even smaller figure would have to be compared with that of 1750.

Today's forests in the interior of the island were only newly planted at the beginning of the nineteenth century. The name of the forester Hans Römer is worthy of mention here, who significantly promoted these reforestations. *"For the establishment of the Bornholm forests—10,600 ha—productive species such as pine, spruce, silver fir, hornbeam, beech and both types of oak were used depending on the varying soil conditions. Of these species, the fast-growing spruce (Picea abies) and also the silver fir (Abies alba) are*

⁹ www.statbank.dk/arealdk, retrieved 22.01.2024.

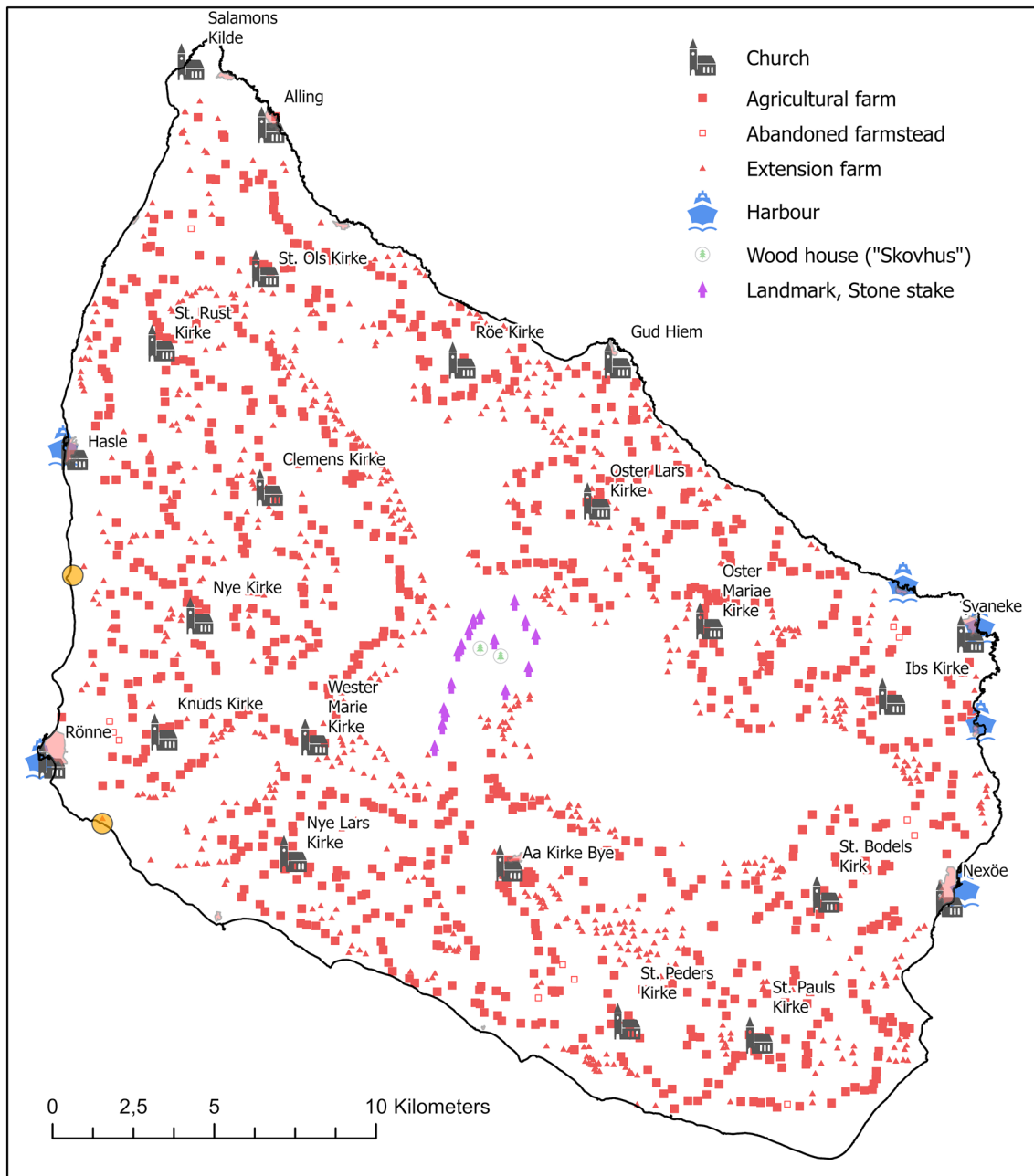


Fig. 5 Churches, farms, settlements and harbours. Editing and Cartography: Walz

certainly not native. The windy climate often leads to storm blowing in the less stable species." (Blüthgen 1975: p. 202).

After the dissolution of the commons, these communally used areas were either afforested or further intensified as agricultural land. This also had a significant impact on biodiversity, as the extensive utilisation of the udmark had led to a high level of structural and species diversity with heathland, extensive meadows and groves.

From the perspective of biodiversity conservation, such areas are valuable today because they have special floristic

and faunistic features and a high level of diversity in general. Today, the extensive use of heaths is only present in remnants,¹⁰ and extensive grassland in agriculture is also rare. At selected places, attempts are being made to preserve it through maintenance measures, for example in Kåsegårds Naturarealer (Bornholms Regionkommune 2005).

¹⁰ See also <https://367ture.dk/ture/smaalyngen/smaalyngen/>.

3.2 Settlements

The settlement pattern of Bornholm at that time was characterised by many individual agricultural farms (see Fig. 5). Only a few villages formed larger coherent settlement areas, such as Rønne, Nexö, Gudhjem or Hasle. There are no larger closed villages in the interior of the island. Even Aakirkeby is little more than a collection of houses at this time. However, 22 churches are recorded, which allow farmers to attend church on Sundays in the coastal villages, but also in central locations around the island. Apart from the world-famous round churches, which are not highlighted as such on the map, they are often stately churches with an attached tower. An exception is the chapel, now in ruins, in the far northwest, which stands directly by the sea at Solomons Kilde (spring), which was a pilgrimage site in the Middle Ages.

The agricultural farms can be divided into so-called "Selvejergarde" (self-owned farms) with the right of inheritance of the youngest son or, where sons were absent, of the eldest daughter. This was the vast majority. In addition, there were the tenant farms ("Vornedgarde") as well as a small number of yeomen, so-called "Frimaend" who were directly subordinate to the Bishop of Lund or the King (Blüthgen 1975: p. 203–04).

To simplify the taxation system, the "Selvejergarde" were entered in a register book ("Jordebog") in 1616 and numbered according to the course of the sun from N via E to S and W. The tenant farms were only given numbers from 1671 onwards, in the order in which they were created (Blüthgen 1975: p. 204). These numbers are also entered in Hammer's map, with the addition of S for the owner-occupied farms and V for tenant farms. A total of 939 farms could be counted on the map. In addition, there are 12 presumably abandoned farmsteads with no buildings in their place as usual, but still the farm numbering and the farm name.

In addition to the agricultural farms, there are 815 extension farms (see Fig. 5). In the map these are called "Udbygger-huus" (usually abbreviated as "udb."). Olsen (1920: p. 87) writes that "uddbyggere" were allocated land from the commons. According to Rawert and Garlieb (1819: p. 250) "udbyggere" are cottagers on royal or private land who earn their living by plugging heather and cutting peat. "Some are fishermen, some are craftsmen, some are millers. Some own the house they live in and take with them when they leave the land; others own both house and land." (Rawert and Garlieb 1819: p. 250). "Most of them live in some prosperity" (Rawert and Garlieb 1819: p. 250). The reference to the Udmark is also recognisable in the map image, as these farms are conspicuously lined up around the Allmende areas used as pastureland / heath (see Fig. 4). 645 of the extension farms are located in or no further than 200 m from such common

land (see also chapter on heathland). The agricultural land of the cottagers' estates is mostly fenced off, which is also reflected in the map image of Hammer's map.

As far as seafaring / fishing is concerned, 6 harbours are listed by name on the map, whereby it can be safely assumed that there were also possibilities for landing small boats in the smaller coastal towns.

Furthermore, two "Wood Houses" in the interior of the island in Almindingen are recorded and named ("Skov Hus"). Presumably they belonged to the "Royal Game Lane", a forest area used as a royal hunting ground for deer hunting. This was marked with oak stakes at the end of the seventeenth century, but as the wood rotted over time, they were replaced in 1722 by 16 stone stakes with the name of King Frederik IV, and a few years later by even more stakes with the monogram of Christian VI. Of these, 15 are recorded in Hammer's map. That there were a lot of red deer on the island is proven by information from 1684, when more than 100 were shot to supply the royal household, and that a few years later it was considered to shoot 400 animals, as they ate a large part of the harvest in bad crop year.¹¹

Hammer's map already recorded the mining of hard coal in two places. At least near Hasle, the legacies of the later intensified coal mining can still be found today. South of Hasle, for example, the general commercial partnership "Hasle Coalworks" was founded in 1843 to mine coal, and in 1848 the "Hasle Coal Factory" went into operation." (Hansen 2013, p. 31), which later, after the end of coal mining, became the "Sorthat brickworks". (Hansen 2013). Blüthgen (1975: p. 197) writes: "Heavy grey clays of the Jurassic (Lias) are exploited near Hasle in an open-cast mine close to the beach. This formation also contains small seams of hard coal, which were mined in open-cast mining in former times or in times of war—in the last war about 37,000 tonnes. The calorific value is between hard coal and lignite. The mine holes are now drowned and form lakes in the pine forests south of Hasle."

Today, coal mining no longer plays a role, but Bornholm is rich in raw materials such as granite, sandstone, gravel, kaolin and clay. Accordingly, there are now a large number of major quarrying sites, many of which have already been abandoned. However, granite in particular is still quarried near Rønne. In the current statistics, as much as 0.6 square kilometres are indicated as quarrying areas (Danmark Statistik¹⁰). However, the historical map does not show any quarrying areas apart from the coal mining mentioned above, which indicates that sand, gravel or clay for house and road construction was more likely to have been extracted in small local quarrying sites, possibly by the farmers themselves.

¹¹ <https://367ture.dk/ture/almindingen-bakketoppe/kongens-vildtbane/>.

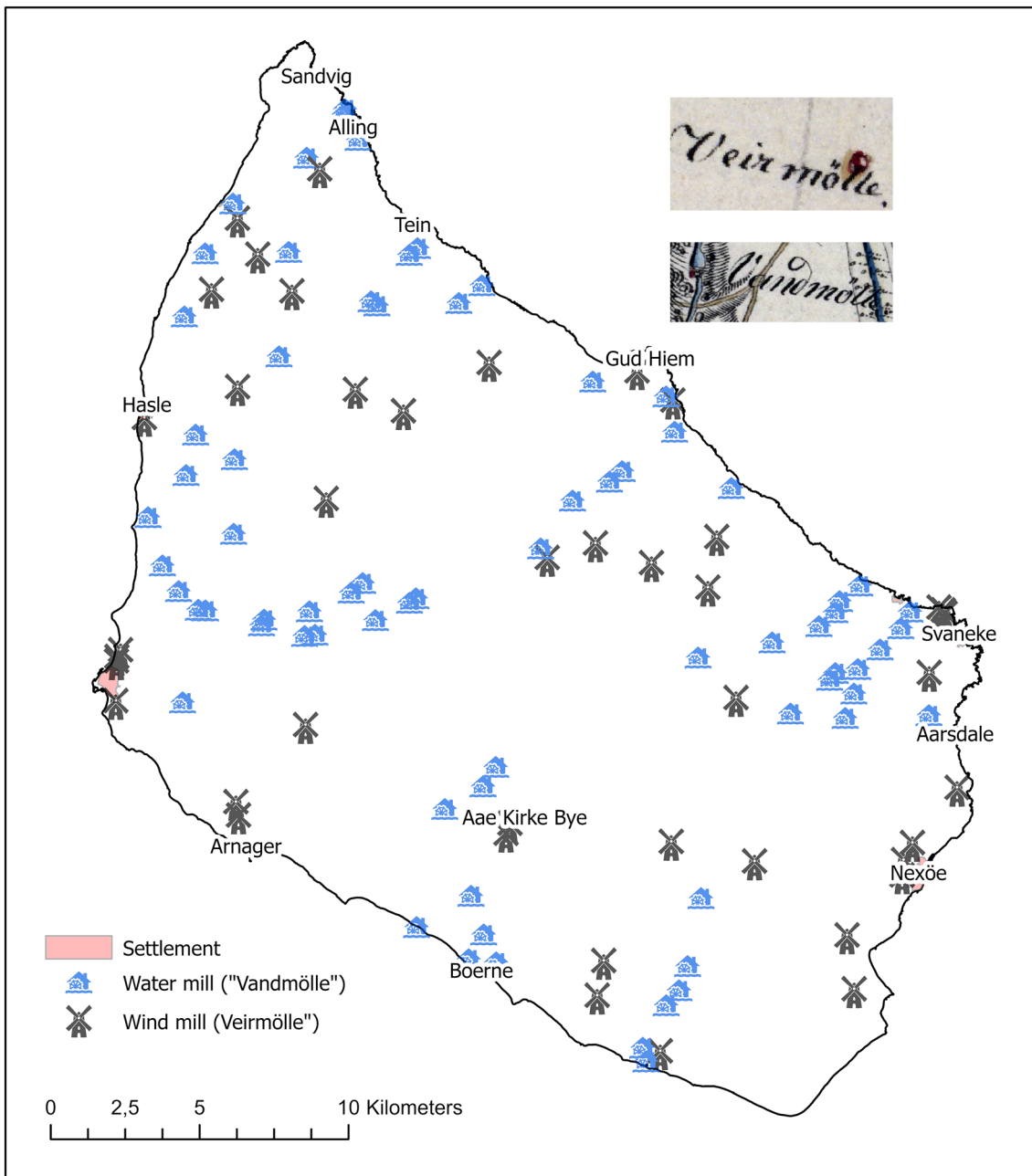


Fig. 6 Windmills and water mills and their location on Bornholm. Editing and Cartography: Walz





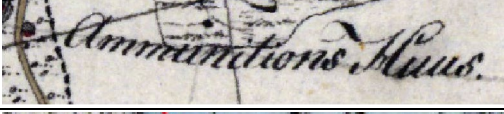
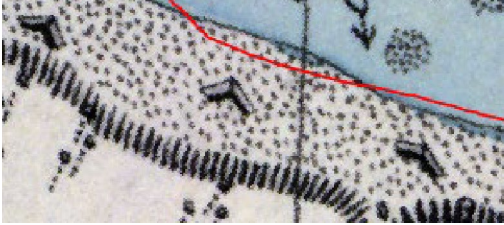


3.3 Windmills and Watermills

Bornholm was rich in wind and water mills at the time the map was drawn. This was probably also due to the fact that milling was not regulated. A mill privilege meant that every farmer who had access to a watercourse could build his own water mill (Hansen 2013: p. 33). Many of the farms were accordingly located along the larger brooks on the island (Fig. 6). Today there are only three water mills left on Bornholm, namely one in Vang and two near Pedersker.

3.4 Fortifications

Bornholm has always been an island exposed to multiple dangers from the outside. Since there was no large army on Bornholm, it was important to prevent possible enemies from already landing. Accordingly, there are a large number of entrenchments on the coasts, i.e. simple ramparts behind which cannons could be set up and defenders could find protection. Hammer's map records these defensive installations in detail with their own symbolism (Table 2). The

Table 2 Symbols of fortifications on Bornholm. Source: See Fig. 2

Map symbol	Object	Quantity
	Battery (here south of Nexö)	7
	Hill fort (here Gamle Borg)	3
	Fortress (here near Rønne)	2
	Powder magazine („Krydhuus“) (here south of Hasle)	9
	Armoury (“Ammunitions Huus”) (here near Hasle)	6
	Earthwork, entrenchment (Skanser“) (here between Rønne and Hasle)	113
	Guard house (“Vagthuus”) (here south of Hasle)	8
	Signal point (“Baune”)	22

map may therefore also have had a military significance, as all the facilities were marked in their location (Fig. 7). In addition to the entrenchments, guard houses, armouries and powder houses are also recorded. These are usually labelled

by name. Of course, also the fortifications in Hammershus and Rønne and their batteries, as well as the three older castles: Lilleborg from the twelfth century and Gamleborg from

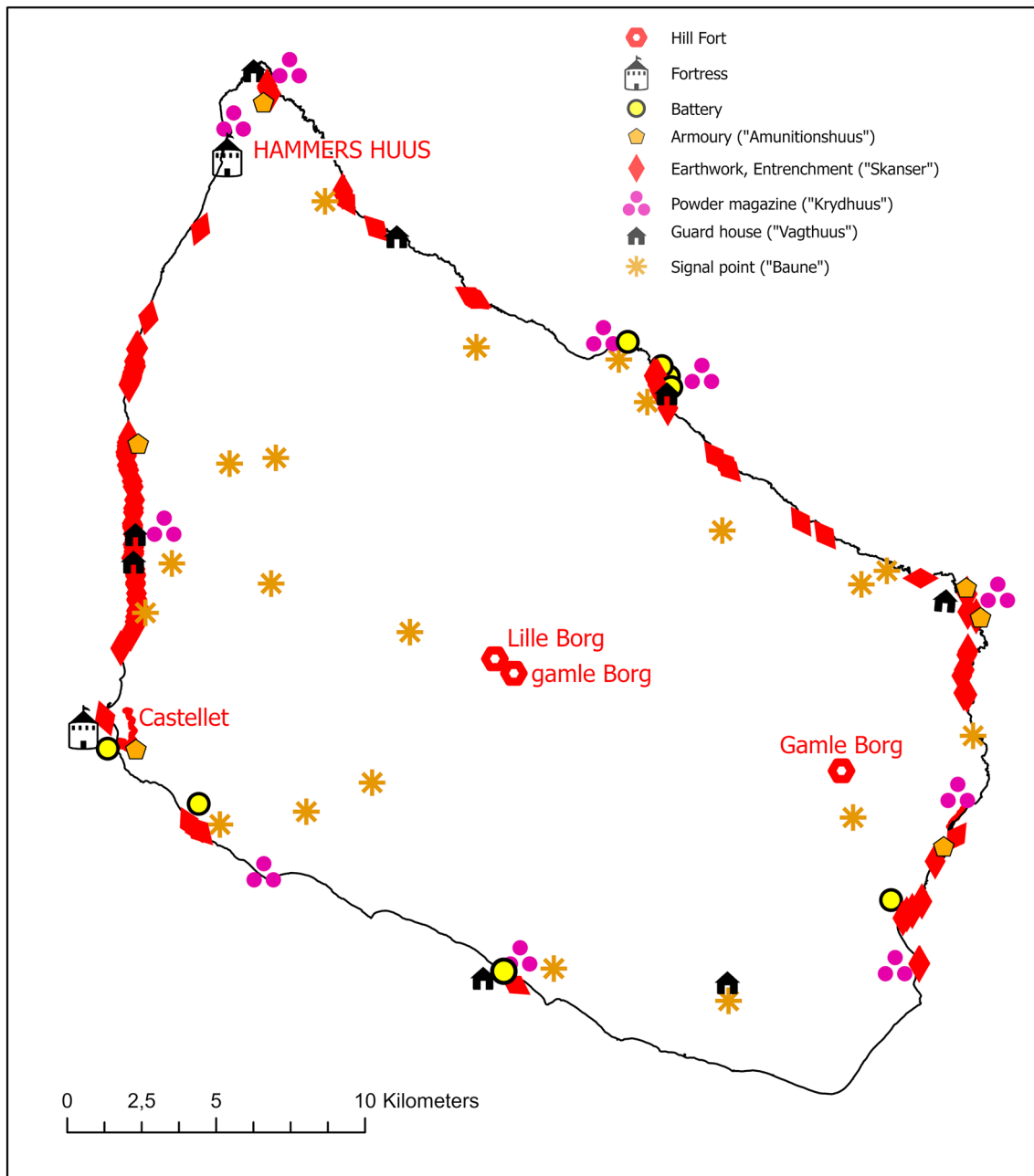


Fig. 7 Defence works and their location on Bornholm. Labelling as shown on the map. Editing and Cartography: Walz

around 750 AD in the interior of the island and Gamleborg from around 400 AD in the east of the island.

According to Hansen (2013: p. 163), only in a few places in Denmark were as many defensive entrenchments built as on Bornholm. In 1808, 214 coastal entrenchments were counted, i.e. on average a defensive entrenchment every 400 m. In Hammer's map 113 were identified. This may also indicate that not every single entrenchment was given a symbol, but groups of entrenchments in one section were only given a common symbol.

It is noteworthy that the map also lists a total of 22 so-called "Baune", which are also marked by the word "Baune". These are signal points set up on high hilltops from which an alarm could be given in case of attacks by fire or cannon shots (Skaarup 2016).

3.5 Stillwaters and wetlands

Still waters and wetlands The evaluation shows above all many small bodies of water, especially ponds, some of which

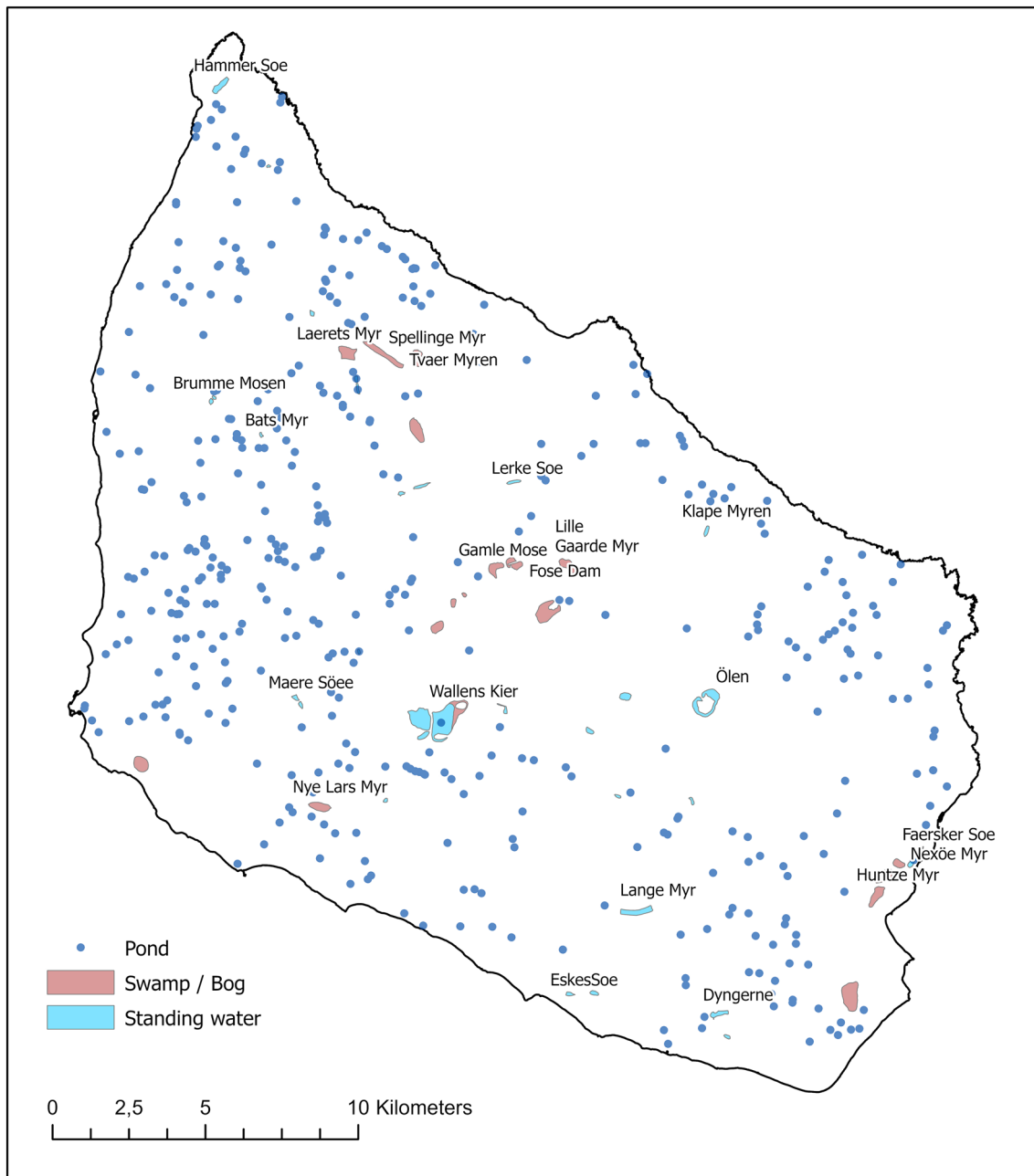


Fig. 8 Ponds, larger standing waters, swamps and bogs on Bornholm. Names entered according to the spelling on the map. Editing and Cartography: Walz

were certainly also artificially created near the farmsteads. A total of 428 such small standing waters were recorded on Hammer's map. However, there are also quite a number of larger standing waters, wetlands and bogs, often referred to as myr or mose (Fig. 8). According to the Dictionary of the Danish Language,¹² mose refers to a "low, flat, wet (sometimes flooded) area of land, the upper layer of which

consists of (partially) transformed plant parts (peat, humus), formed by the overgrowth of a lake, stream, etc.". 18 such larger swamp or bog areas with a total area of approx. 293 ha as well as 33 larger standing waters with a total area of approx. 260 ha were surveyed.

In their geographical description of Bornholm from 1815, Rawert and Garlieb (1819: p. 252) wrote: "*Peat bogs are scattered all over the country. There is hardly a mountain valley without peat; [...]. We walked over wide stretches where both the appearance of the soil and the plants growing*

¹² https://ordnet.dk/ods_en/dictionary-1?query=mose&set_language=en

on it bore witness to peat ...". The peat was extracted as fuel. Rawert and Garlieb describe the ecological consequences, as areas after peat extraction would find it very difficult to vegetate themselves and cultivation would be very complicated. (Rawert & Garlieb 1819: p. 107). At the same time, however, they also point out that many peatlands were not used at that time (Rawert and Garlieb 1819: p. 252). At the time of the recording of Hammer's map, there were therefore probably still many intact moors. In modern times, however, these have often been drained due to the intensification of land use, such as the "Nye Lars Myr", which was still recorded on Hammer's map.¹³ In recent years, efforts have been made to recultivate some areas. One example is Ekodalens Moser, which was renaturalised from 2017 to 2020.¹⁴ This also applies to the many small water bodies that once existed (see Fig. 8).

4 Discussion

To be to interpret the meaning of a historical map, the history of its creation and the original aims of the survey at that time must always be included in the analysis. From the detailed description in the introduction of how the mapping and surveying work on the island of Bornholm came about, it is clear that the commandant's office wanted to produce a map for military purposes on the one hand. This is supported by the accurate recording of military installations such as fortifications, entrenchments, powder houses, signal posts etc., which are explained in detail in Chapter 3.4, as well as the precise mapping of roads and paths. On the other hand, it also dealt with tax issues, i.e. which utilisations, e.g. agriculture and forest, provided taxable income. This is supported, among other things, by the very precise listing of the agricultural farms with their names in the tax register (see Chapter 3.2.).

From the perspective of scientific theory, this is therefore a positivist view of landscape, i.e. landscape is understood as an object that can be empirically recorded by measuring, weighing and counting (Kühne 2019). Nevertheless, it can also be seen as a constructivist understanding of landscape, as the selection of what was mapped and recorded was based on the ideas of those responsible at the time, in this case administrators and military experts and their view of the landscape. In this respect, the map of Bornholm can also be seen as an expression of the ruling system of power. Above all, the landscape objects that were important for the system of the time were recorded, e.g. the tax register (see Chapter 3.2.).

However, this is not so important for our question of how the landscape has changed, as the main land covers and land uses that are also included in topographical maps today were recorded. In general, similar to today's topographical maps, the aim was probably to depict the landscape, which was useful for the general administration of the island as well as for military and tax purposes. The view of what was mapped at that time is very well documented and comprehensible in maps of the time through very descriptive, sometimes almost pictorial legends.

Thus, the map vividly shows the landscape of Bornholm in the eighteenth century. This was very different from the state of the landscape today. The changes are so serious that the former landscape is hardly imaginable for today's inhabitants and visitors without a deeper study of the subject. This article is intended to contribute to this. The results have therefore also been put online and can be explored interactively as a map.¹⁵

As a significant change in the landscape, the most striking feature is the formerly very large proportion of heathland and the very small proportion of woodland. Today, almost all of the former heath areas have been afforested. This was only possible by replacing old, traditional systems of use, such as communal grazing on the commons, and transferring the land to private or state ownership. This system also included driveways that connected the farms with the commons and stone walls that demarcated these areas from the neighbouring fields. From today's perspective, these corridors formed a network of extensive fringe structures that provided highly diverse habitats for plants and animals, for instant insects. The high number of small water bodies, often close to the farms, is striking; they were certainly often artificially created and necessary for the supply of livestock. At the same time, these also provided valuable habitat for amphibians and insects, such as dragonflies. Even if you look at the forests and their distribution in the landscape, you notice that there was much less forest in percentage terms than today. But there were small patches of forest interspersed everywhere between the agricultural areas. In some places, shrubby wooded areas are also identified separately, often due to the relief, along stream valleys. This leads to an interconnection of woody habitats such as forests, copses and hedges. Overall, a picture of a diversely structured cultural landscape with high proportions of extensive uses such as sheep and cattle pastures, heathland, etc. can be drawn. Considering that agriculture at that time did not use fertilisers and pesticides, a very high level of biodiversity must have been achieved.

¹³ See also: <https://367ture.dk/ture/i-myrene/myregaardsmyren/>

¹⁴ <https://naturstyrelsen.dk/naturbeskyttelse/naturprojekter/ekodalens-moser/>

¹⁵ <https://arccg.is/0XOGv5>

5 Conclusion

From a cartographic point of view, the map by Hammer or the copy by du Plat is a very accurate and detailed map of its time. The multitude of land uses such as forests, heaths, waterways, etc., but also cultural elements such as buildings (mills, churches, etc.) and defensive fortifications are accurately listed and very well suited to today's map bases. It can be considered exemplary that the Danish state archives make such data freely available for analysis.

The analyses of the contents of Hammer's map of Bornholm show the strong changes in the landscape resulting from changes in social systems and the associated modes of use. On Bornholm, as in many parts of Central Europe, these changes were associated with intensification of use and mechanisation. In particular, methods of use such as the grazing of commons led to a completely different landscape with large proportions of open heath areas. Today, such structures can only be maintained or imitated in small areas for nature conservation and landscape management reasons. However, small-scale structures such as seams, copses or small bodies of water, which were more common in the past, could also be integrated into modern agricultural practice.

The study of historical maps in particular can contribute significantly to a deeper understanding of landscape, its development and the role of humans in it. This can be essential for understanding why the landscape looks the way it does today. Valuable clues can also be gained when it comes to further developing landscape, be it from the user's point of view, but also from the point of view of nature conservation and especially biodiversity protection. What habitats, what user structure existed in the past? Especially when it comes to renaturation measures, this can be of importance.

In this sense, it is to be hoped that this evaluation will be of particular interest to local people to landscape and nature conservation, landscape management and the regional historians as well as interested visitors of the island.

In addition, further manifold scientific questions are possible, which now open up new possibilities for analysis due to the possibilities of spatial overlaying of land use data ("intersection") with other social (e.g. population and tax data, ...) and natural data (e.g. geology, soil, biodiversity, ...).

Funding Open Access funding enabled and organized by Projekt DEAL. The publication of this article is funded by the Open Access Publication

Fund of Hochschule für Technik und Wirtschaft Dresden – University of Applied Sciences.

Declarations

Conflict of interest The author have no relevant financial or non-financial interests to disclose.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Blüthgen J (1975) Bornholm: Ein Beitrag zur Landeskunde der dänischen Ostseeinsel. *Erdkunde* 29(3):194–209
- Brandt A (1958) Beretning: Bornholms Efterslægtsselskab og Bornholms Landøkonomiske Forenings virksomhed, 1805–1955. Rønne (Bornholms Tidendes Bogtrykkeri), p 575
- Hansen F (2013) Bornholms Natur: 367 Erlebnistouren, 1. Aakirkeby (Verlag Natur Bornholm), Deutsche Auflage, p 336
- Kühne O (2019) Zwischen Macht und Essenz, Konstrukt und Objekt? Wie Landschaftstheorien Deutungskonkurrenzen von Natur zeigen. *Stadt und Grün* 12:24–27
- Olsen J (1920) De Bornholmske udmarksjorder. *Bornholmske Samlinger* 13:82–132
- Rawert OJ, Garlieb G (1819) Bornholm beskrevet paa en reise I aaret 1815. Kopenhagen (Schubothé), p 274
- Bornholms Regionkommune (2005) Plejeplan for Kåsegårds Naturarealer: 49 p. Available at: <https://www.Brk.Dk/Borger/Miljoe-Natur-Energi/Naturen/Documents/Plejeplan%20k%C3%A5seg%C3%A5rd%202005.Pdf>. Accessed 29 June 2023
- Skaarup JC (2016) De Bornholmske Kystskanser samt Bavner, Magasiner, Krudt- og Vagthuse. Rønne (Bornholms Forsvarsmuseum), p 151
- Walz U, Berger A (2003) Georeferenzierung und Mosaikerstellung historischer Kartenwerke - Grundlage für digitale Zeitreihen zur Landschaftsanalyse. – PFG-Zeitschrift für Photogrammetrie, Fernerkundung und Geoinformation 3:213–219