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The early extinction date of the beaver (*Castor fiber*) in Britain

Abstract This paper re-examines the evidence for the extinction of the beaver (*C. fiber*) in South Britain and Scotland. Much of the evidence found by previous scholars is discounted as unreliable or outdated. A new study looks at reliable historical sources and studies references to the beaver in the context of references to comparable mammals, especially the most ecologically comparable (polecat (*M. putorius*), pine marten (*M. martes*), otter (*L. lutra*) and badger (*M. meles*)).

Each of these mammals was present in every period studied, meaning that medieval authors were reliable witnesses to the species' presence. The beaver is present in comparable numbers to the other mammals in South Britain 1188-1307 and in Scotland 1526-1600, meaning that as a species it was frequently recorded by humans. References to it cease after 1308 in South Britain, except a single anomalous entry, and after 1600 in Scotland. The idea that this reflects a sample bias or random chance is discounted. The paper rejects the late extinction scenario and concludes that the beaver became extinct by 1300 in South Britain and by 1600 in Scotland.

Keywords: beaver, medieval Britain, historical sources, medieval British animals, extinction.

1.1 Introduction and Literature Review

Traditionally the beaver (*Castor fiber*) is supposed to have become extinct in Wales and England somewhere around 1200 A.D. after which it was confined to Scotland until around the 15th or 16th century A.D. when it became extinct there as well (Dent, 1974; Kitchener & Conroy, 1997; Yalden, 1999). This view has been recently been challenged by Bryony Coles at Exeter University. The end of Coles' (2006) book, *Beavers in Britain's Past*, argues that the only thing scholars have really proved for the twelfth century onwards is the loss of awareness about this animal in the local areas. According to the most recent version of her theory (2010), beavers certainly survived into the eighteenth century in Britain and may have survived into the nineteenth. These two opposing hypotheses can be termed the 'early extinction scenario' and the 'late extinction scenario' for convenience.

Although Coles' book is highly praised by academic reviewers (Yalden, 2007; Zeiler, 2007), the late extinction scenario is treated more cautiously. The *Handbook of British Mammals* still terms the suggestion 'tentative' (Harris and Yalden, 2008) and the late extinction hypothesis has not yet been

fully accepted by the academic community. The difficulty is that there is very little evidence either for or against the presence of beavers in the later medieval and early historic period, and the little that exists is fairly ambiguous after the 15th century.

This paper aims to refute the late extinction scenario. The first half critically examines the late extinction scenario, and explains why it is unsatisfactory, both from a modern ecological point of view and the point of view of the medieval evidence. The second half quantitatively tests the early and late extinction scenarios against a near-exhaustive list of medieval texts, by comparing how many times wild beavers are mentioned in medieval sources compared to the other most comparable, larger-sized, low profile mammals.

1.2 Criticism of previous studies

In essence the early extinction scenario looks at the last positive sightings of the beaver and the late extinction scenario looks at the earliest attestations that the beaver is extinct. Unfortunately both of the theories rely on an unreliable evidence-base. It is not within the scope of this paper to reinterpret the entire medieval record of beavers but scholars writing on this subject in the past have tended to only reference other ecological histories and thus have fallen out of touch with contemporary historicism. (Table 1) shows the first beaver study to quote each source and demonstrates how little the evidence base has changed in the last century. Several of the texts used by beaver scholars have been re-interpreted and some even debunked by historian and literary scholars but are still used by ecologists today. I will point out only the most important revisions here:

1.2.1 Three texts need to be re-conceptualised

- The 'Laws of Hywel Dda' are now more commonly referred to as the 'Medieval Welsh Law Codes' and are made up of a number of medieval Welsh lawbooks. Hywel (d.949/50 A.D.) may have codified some medieval Welsh laws, but the ones that survive should properly be regarded a product of 13th century codification (albeit with some earlier material) and not a relic of the tenth century (Charles-Edwards, 1989).

- ‘The Scottish Act of David I’ and ‘The Law of Robert the Bruce’ are actually two generic names for the same text called the ‘Assisa de Tolloneis’ (The ‘Toll Assizes’). The list mentions ‘gris’, the greyed fur of the red squirrel found only in Scandinavia and north Russia, meaning the list is not wholly made of native species. This text is preserved within the ‘Assises of David’ and the ‘Custuma Portuum’. Although attributed to King David I of Scotland (ruled 1124-53), this law was actually more probably collected by King Robert I around 1318 (Taylor, 2012). He likely collected the toll list along with the ‘Newcastle Custumal’, perhaps from the Percy Chartulary. The ‘Newcastle Custumal’ can be securely dated to prior to the end of the twelfth century, (Johnson, 1925) but the accompanying toll list is not found in the earliest manuscripts and is probably also only datable to the early fourteenth century.
- There are no beavers at all in the 1586 first edition of Camden’s *Britannia*. In the 1607 edition and the first English translation by Philemon Holland in 1610 a note is added that beavers are no longer to be found in the Teifi (as had been stated by Gerald of Wales in 1188). There are no remarks about place-name evidence, nor any indications that the word ‘afanc’ refers to the beaver until a further note is added to Gibson’s (1695) translation.

1.2.2 Some evidence is no longer convincing

- It is no longer appropriate to talk about artwork prior to the 16th century being drawn from or inspired by life (D’Aronco & Cameron, 1998; Backhouse, 2002; Raye, 2013). Medieval beavers are almost exclusively depicted castrating themselves based on a common piece of folklore. This idea is first attested by classical Greek and Roman authorities but was popularised in the medieval period by Isidore of Seville and the Latin Bestiary tradition.
- Over the last century historians have become more cautious in using folklore to establish historical facts. Unless corroborated by other evidence folklore should not normally be taken literally as an archaeological artefact but interpreted symbolically as a source for

decoding the cultural significance of historical events and landscapes (Gazin-Schwartz & Holtorf, 1999).

- Evidence of the use of animal fur and animal products in medical and cooking texts does not prove local species abundance. Recipes were copied from manuscript to manuscript and meats were imported. There was a strong international trade in furs like ermine, genet and beaver (Veale, 2003).
- Single parish records like the 1789 Bolton Percy Record, need to be considered in the context of Lovegrove's work (2007). He looked at the records in bulk and did not find evidence of beaver culls. Beavers were not 'included as vermin in the Acts for the Preservation of Grayne' (Coles, 2010) as we shall see later. The names of extinct and rare animals are often redefined to more common survivors (Yalden & Albarella, 2009; Shepherd, 1903). Compare Lovegrove's (2007) record of 'fairy heads' from the St. Teath parish record (actually vair-heads – heads of weasels).
- It is very difficult to date the creation of a place name, and therefore place names only establish possible presence, not extinction date. The term 'afanc' in early Welsh literature originally refers to a water monster and not the beaver until the seventeenth century (Aybes & Yalden, 1995). Folk etymologies are almost never to be trusted. Nant Ffrancon was named after a Frank, not an 'afanc'.

1.2.3 Summary of Previous Reliable Evidence

The beaver was almost certainly present until at least 1188 A.D. in South Britain and 1526-7 in Scotland. There are archaeological remains from Saxon and Norman England, Old English place names and evidence from Gerald of Wales in 1188 and from Hector Boece of Scotland in 1526. Beavers are said to be found in only one river each by these writers. After this, there is very little evidence either way on the subject until the seventeenth century when writers commenting on their predecessor's books begin to doubt the beaver's continued presence. The earliest of these accounts are the 1607 edition of Camden's 'Britannica' for South Britain (supported shortly

afterward by Drayton's 'Polyolbion') and Robert Sibbald's 'Scotia Illustratia' in 1684 for Scotland. There is some room to doubt these texts, especially Sibbald's ambiguous statement (Coles, 2006; 2010), but for the present they are useful in providing a window of time to study. The record is ambiguous about how long the animals endured between c.1188 and 1607 in South Britain and at least 1527-1684 in Scotland.

1.3 The Invisible Beaver Hypothesis

In his 1977 book *Le Castor et son Royaume*. Blanchet suggested three possible models to explain local beaver survival to the present era on the Rhône: (i) humans could have not cared about the animals, (ii) the environment could have been too inaccessible to hunt beavers and (iii) beavers might have been able to live invisibly in their habitat, as long as the water was deep and foliage provided cover.

Blanchet's argument is deductive in tone, looking to explain the verifiable fact that beavers survived in France until the present era. This is significant because when Coles (2006) adopted the explanation she used it inductively – If beavers could exist invisibly, medieval writers may not have been qualified witnesses as to whether or not the species was actually present. This is not necessarily a problem as long as Blanchet's explanation is correct. However Blanchet himself pointed out several difficulties: the beaver disappeared from other French rivers earlier and some of the parts of the Rhône where it lingered were not overgrown but open to view. He preferred option (i), human disinterest, or a combination of all options to option (iii), invisibility. Blanchet also admitted that each of the options was hypothetical, since he was not able to find any medieval evidence of human opinion.

Further, modern studies emphasise the portrayal of the beaver as a keystone species rather than a low profile one. This is because beavers manage their own habitat, building dams and felling trees to create floodlands that naturally encourage the growth of a wetland ecosystem, benefiting a huge variety of plants, trees, invertebrates and wetland birds and animals. For example, a small

number of beavers were introduced or escaped to the River Tay before 2006 and since then they have caused damage to orchards, salmon fisheries and agricultural crops. The latest survey found 1,522 field signs, six beaver sightings, 72 burrows, 10 lodges and seven dams, suggesting 38-39 family groups making an overall estimated total of 146 beavers present on the river (Campbell, 2012). This report was possible because, compared to almost any other mammal, beavers leave so many signs of their presence that they are relatively easy to survey. A comparable survey was commissioned by the Devon Wildlife Trust to assess how the release of two beavers into a 3ha enclosure has affected the immediate environment. Southwest Archaeology found the animals had 'a dramatic impact upon their immediate environs'. They had built and maintained canals, dams, thinned tree cover and ensured local retention of water (Walls & Morris, 2013).

Coles herself (2006), on her fieldwork in France identified 11 results of beaver presence on the landscape (burrows, dens, exit paths, dams, ponds, by-pass-channels, canals, lodges, dead wood, local retention of water, enhanced biodiversity), some of which were visible even in the archaeological record. When we add the 'sure sign[s] of beaver presence' like stripped willow twigs and castoreum deposits which she often smelt before seeing, Coles' (2006; 2010) position that the beaver could exist invisibly for centuries seems unsustainable, and this in turn makes the absence of medieval records more troubling.

In light of the extent to which beavers alter their environment, Blanchet's (1977) theory of beaver-invisibility must be viewed as highly suspicious.

1.4 Hypothesis

The late extinction scenario states that the reason beavers are absent from later texts is that they had a low profile and that medieval authors may not have been trustworthy witnesses to their presence. The second half of this paper will test those arguments by comparing the number of references to the beaver with the number of references to other comparable species across time.

According to the early extinction scenario, beavers should be present in the early texts to an equal extent to other species, and then suddenly disappear while other species continue to be seen.

According to the late extinction scenario, beavers should be either absent or only sporadically present throughout the periods. Other low-profile species may also be only sporadically seen.

While the complete absence of beavers will not disprove either theory, their abrupt disappearance would disprove the late extinction scenario and their continuous low-frequency presence would disprove the early extinction scenario.

2.1 Methodology

A list of the most reliable medieval texts from the period 1188-1607 in South Britain and 1526-1684 in Scotland was collated. References to the four mammals identified as being most ecologically similar to the beaver, along with references to the beaver itself were collected. Texts which mention less than two of the five species (otter, pine marten, polecat, badger and beaver) were discarded. References to deer, foxes, wolves and wild boar, and wild cats are collected but not individually searched for. (I reserve comment on the lynx for a future paper but the bear seems to have gone extinct too early to be mentioned.) The number of times each text mentions each of Britain's large, wild mammals as living outside of captivity is recorded. All colloquial names are included. The aim is to test whether or not medieval authors are reliable witnesses to the mammal fauna of their era.

The sources searched include histories, law texts, travelogues, hunting manuals and vermin control texts from South Britain c.1100-1607 and from Scotland c. 1526-1684. I have not included animals referenced in bestiaries, beast literature, hagiography, most poetry, secular stories or in glossaries as these texts contain too many animals interesting to medieval people but not native like unicorns, lions and dragons. Customs charges, ports' rosters, wills and medicals are also not included since several animals not found in Britain were routinely imported for their fur or the medicinal use of their bodies (e.g. sable, lettice), meaning that these texts are not reliable

witnesses to the state of the native fauna. I use almost exclusively digitalised editions which can be searched in order to quickly find references to the mammals.

The study is close to exhaustive in terms of historical references to wild animals because the earliest references to these animals are collected by the dictionary projects of several of the medieval languages of Britain: the *Geiriadur Prifysgol Cymru*, the *Dictionary of Medieval Latin from British Sources*, the *Oxford English Dictionary* and the *Dictionary of the Scots Language*. The concordances of these dictionaries are not complete: they do not include texts recently edited, or texts about Britain written in foreign languages. I have added several references not found in the dictionaries, some of which I am aware of through previous research and some of which I have found in near-exhaustive searches of, for example, the genres of travelogue and medieval British hunting manuals.

3.1 Results

(Table 2) shows the number of times each species was referenced in each medieval text. Notes explaining alternative interpretations of the texts can be found before the References.

The following graphs collect the texts into periods: 1188-1307, 1308-1500 and 1501-1607 for South Britain and 1527-1600 and 1600-1684 for Scotland. The charts show what percentage of texts from that period mention the animal at least once:

Fig 1. A series of bar charts showing what percentage of the South British medieval texts each species is mentioned in.

Fig 2. A series of bar charts showing what percentage of the Scottish medieval texts each species is mentioned in.

We can test the hypothesis that the beaver was missed by chance by tabulating the number of observed beavers in this time period with the expectation value of the number of beavers according to the probability of observation from the 1188-1307 period.

A Chi-Squared probability test can then tell us whether the change in the number of texts is statistically significant.

1. *H0 (null hypothesis): That beavers were extinct in Britain by the period 1308-1607.*
2. *H1: that beavers were not extinct in Britain in the period 1308-1607.*

Chi-squared= **8.3**, i.e. A 0.4% chance at 1 degrees of freedom that the hypothesis is true and a 99.6% chance that the null hypothesis is true (i.e. that beavers are extinct), although see Limitations section for difficulties.

We can also plot the sightings from South Britain, 1308-1607 on a Species Accumulation Curve chart. If we disregard the single 16th century beaver result and also sightings of wolves which only appear in the earlier texts, and then randomise the order of the texts the curve looks like this:

Fig 3. A randomised curve showing how quickly the species of large mammal other than wolf and beaver tend to be found within the later texts.

This shows that all species of animal other than beaver and wolf were very quickly seen in the texts.

Finally, the relative frequency of the animals in the texts can be best counted by considering the animals as ratios, as shown in (Table 3) and (Table 4).

4.1 Limitations of the Evidence

The nature of the evidence means that there are some serious limitations which prohibit drawing conclusions based on the exact reported frequency of each species:

There is a bias in that the methodology especially selected for the five target species, but collected data on ten species in total. This means that the badger, otter, beaver, marten and polecat are actually over-represented in our texts. However, as shown in (Table 3) and (Table 4), this bias is obscured by the source biases.

The Scottish data is biased towards more exciting seeming species recorded by exoticising travellers, and also to more valuable species recorded by over-patriotic historians. A future researcher might profitably study how many lions (*P. leo*), reindeer (*R. tarandus*) and sables (*M. zibellina*) are included in the various Scottish texts to evaluate how compromised they have been by their biases. The South British data is biased towards hunting animals recorded in hunting manuals, licenses and serjeanty texts and vermin species recorded in pest-control tracts.

The sources are geographically biased as they are almost exclusively written in urban areas. Most seriously, very little Welsh evidence is considered after 1300. Texts by Guto'r Glyn, Dafydd ap Gwilym and the 'Naw Helwriaeth' were considered, but did not pass the tests described in 2.1. This limitation is not too serious as other south British texts describe Wales. There are insufficient Scottish texts to carry out statistical tests.

There are also minor potential technological limitations created by the methodology. The study used texts which have undergone OCR (optical character recognition). OCR is an established technique, but it still has trouble with foreign languages and non-standard scripts. Some but not all of the texts have been checked by human proof-readers.

There is an element of researcher-subjectivism in interpreting and translating of the reports. Medieval texts do not use a standard spelling system and regional, colloquial, orthographic names vary from text to text. Occasionally it is difficult to objectively identify the species based on a single reference. It can also be unclear whether a reference was to a wild animal or to a tame animal, or whether the text is merely referring to common medieval knowledge. For example, lists of collective nouns 'a herd of deer, a gaggle of geese' are common in the medieval period and were not considered to be references to wild animals, There were also several ambiguous references to swine and cats, which could have been wild or tame. Where this changed whether an animal was reported as present or absent in a text a note was included in the Notes section (8.1).

These limitations are serious, and prevent the extrapolation of this data into relative abundance levels. However, the limitations do not undermine the use of the data for determining presence/absence for four reasons. First, any bias affecting a species is likely to continue to affect it through each period. Second, the final two limitations are likely to affect all species equally. Third, for the most part every animal is represented in every period, meaning that the medieval authors were reliable authorities. Fourth, the Chi-Squared test performed above allows us to balance

against sample bias since it considers only the relative percentage presence across time, not across species.

Although suggestive the Chi Squared test is not necessarily conclusive in this instance. Our value seems to approximate the expectation value of other species from the time period but the small sample of six texts which gave us the expectation value is a poor basis for a strong conclusion. If we check the expectation values of the other species against the number observed we find that many of them do not correspond. See (Table 5).

However of those that do not correspond (polecat, marten, otter, wolf, boar, beaver), all except the wolf and beaver are actually present in more texts than expected. This means that the coverage from 1308-1607 is generally *better* than expected based on the 1188-1307 data. The discrepancy in number of wolves observed can be explained since wolves go extinct in this time period. The discrepancy in number of beavers observed vs. expected therefore not only still requires an explanation, it actively defies the trend followed by all the other target species.

5.1 Conclusions

Notwithstanding the limitations above, the late extinction scenario may be discarded. The medieval authors are reliable sources to the presence of every other comparable mammal, and are reliable sources for the presence of beavers in the twelfth and thirteenth century south Britain and sixteenth century Scotland. Chi-squared analysis shows that the almost complete omission of beavers from later texts in south Britain was not due to chance. The beaver was not invisible in the early period and there is no reason they should have suddenly acquired and maintained a lower profile than, for example, the pine marten and polecat, over the centuries after 1300 in South Britain. The same is likely to be true for the year 1600 in Scotland. This is especially true since our other target species (badger, pine marten, polecat, otter) are all better represented after 1300 than before.

The fact that the beaver reappears in one English text from the late 16th century, the 'Chronicles of England and Ireland', should not affect our judgement on the matter. I discussed this text in the first half of this paper and suggested that the reference there was likely to be an anomaly. The passage is entirely derivative of Gerald of Wales' twelfth century account of the River Teifi, and, considering the absence of any other records from 14th, 15th or 16th century South Britain, it is simply not a convincing record.

On average the other mammals in our survey are mentioned in nine texts south British texts after 1308. The polecat and pine marten are found in nine and 10 other texts each. Looking at the respective values pre-1308, I do not believe that these animals should be considered as having a profile 9/10* more visible than that of the beaver, which is only mentioned in one of the 12 texts after 1308. The otter and badger, which ecologically may be the most similar animals to the beaver, are mentioned in 10 and 11 texts respectively after the end of the period when the beaver disappears. The randomised species accumulation curve 1308-1607 shows that all the species present were identified almost immediately. The curve did not look significantly different based on what order the texts were randomised into. As long as wolves and beavers were not present all species tend to be observed within three texts and are always identified within five. The fact the accumulation curve reaches its plateau so early suggests that beavers should not be expected even from a larger sample.

Just like the wolf and wild boar, we know that the reason that the beaver is absent from texts at the end of the period is probably because it becomes extinct because we are explicitly told so in 1607 for South Britain and in 1684 for Scotland. It seems counter-intuitive to require a different reason for the creature's absence from the early texts than for its absence from the later texts. For an animal to be living in the wild but absent from one or more centuries of texts simply because people were not aware of it, it would need to have a lower profile than even the polecat, since the polecat is still mentioned in 50% of the texts from 14th and 15th century South Britain. This is

patently untrue of the beaver. I talked in the first part about its role as a keystone species, and it is clear from the early 13th century evidence in South Britain and the 16th century evidence in Scotland that the animal had a high profile there as well.

If we reject the idea that the animal was more invisible than the others or that its omission was by chance, we are left with one other conclusion: the beaver became extinct in South Britain by 1300 and (more tentatively) only survived in Scotland until around 1600.

These dates are consistent with the surviving archaeological evidence for the beaver in Britain as provided on (Table 6). Coles has recorded two sets of remains with potential dates beyond 1300 A.D. (Jarrow, 1100-1400; Wolvesley, 1100-1500); it is suggested that these remains both belong to the first half of their respective date ranges. I am not aware of comparable archaeological evidence for the other target species although Yalden (1999) records some Saxon remains of badger, otter and pine marten.

6.1 Implications

It has been pointed out previously that throughout most of northern Europe, the wolf was extirpated early, and the lynx (*L. lynx*) lingered until later, whereas in the Mediterranean countries the opposite is true (Breitenmoser, 1998; Halley, 2012). This may be due partly to the early deforestation of countries bordering the Mediterranean Sea, and the existence of walled settlements in northern Europe. However, Britain follows the Mediterranean rather than northern European model, losing the lynx early and the wolf much later on. This is especially relevant to our circumstances because although most of Europe also supported populations of beavers until relatively recently, the animals were lost earliest from parts of the Mediterranean (except France). Since beavers were extirpated centuries after the lynx, the cause of the loss of the beaver is unlikely to be the same as the cause of the loss of the lynx. Animals under pressure often become extinct on the peripheries of their range before the heartlands, and it may have been more

significant that populations could not be restocked. The Mediterranean represents the extremity of the beaver's range, and Britain is an island.

It has been hypothesised that the extinction of the beaver across Europe was provoked by human over-exploitation (Harting, 1880; Dent, 1974). This is suggested by many of the final references to the beaver which almost exclusively refer to the animal's exploitation for its fur. Coles (2006; 2010) has suggested that the beaver may also have been exploited for its castoreum and meat and has found archaeological evidence of butchering marks. However this is unlikely to have been the primary reason for the creature's exploitation in Britain. Gerald of Wales' account in 1188 exoticises the demand for beaver meat to 'Germania' and the demand for beaver castoreum to 'the east'. Exoticising is a common medieval method of distancing the author from something they have read without refuting its truth value. Gerald emphasises that in Britain the beaver was hunted for its skin (see Sources section, 8.1.1). It is also significant that beaver fur, rather than beaver castoreum or meat was constantly imported from northern and eastern Europe, and eventually America along with several other high-status furs throughout the period covered by these sources (Veale, 2003). The demand for beaver fur, castoreum and meat has now disappeared in Britain meaning that the primary cause of their decline is no longer in effect.

Geographically there is another very important point to make. Our study shows that the beaver became extinct in South Britain around 1300, but lingered on in Scotland until around 1600. This is not a unique situation. Scotland over the course of the twentieth century has frequently been a haven for wildlife lost from most of South Britain. Wildcats are now only found in Scotland, red squirrels have a haven in Scotland, although they are still found in several other isolated areas around South Britain and pine martens are functionally extinct outside of Scotland (Buttriss, 2014). Our study has shown that wolves too went extinct in South Britain centuries before they were lost from Scotland, and this appears to be a norm for mammals in decline. The fact that Scotland has remained a haven for wildlife over the last seven centuries rules out population density and

increased woodland coverage as possible factors explaining this trend. Perhaps poor environmental management, habitat fragmentation and more intense oversight of habitat was also partly responsible for the beaver's decline. Even today 76.5% of English land-use is developed (arable, improved grassland and built-up gardens), compared to only 24.6% of Scotland and 50.6% of Wales (Morton et al., 2011). The first royal forests in England were probably created before the Norman Conquest, but the systematic transformation of wilderness into privately owned forest and parks, with jealously guarded rights of chase and warren came to Britain with Norman culture after 1066. Although Scotland had royal forests it was not managed to the same extent as Norman England. This secondary cause of decline is also unlikely to influence modern beaver populations as much of the country's remaining undeveloped land is protected and is in the process of being linked by green corridors and buffer zones.

Determining the local extinction rather than just the continued non-observation of an animal has always been a problematic task. It is true that absence of evidence is not necessarily evidence of absence, but this study has demonstrated that accidental omission of species from reports can at least be firmly rejected. It is envisaged that a similar method could be used to determine the modern presence/absence of charismatic animals in areas where longitudinal scientific studies are difficult.

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8.1 Notes on Results

- Numbers (in brackets) reflect references to wild animals outside of Britain.
- The medieval Welsh laws, (Welsh: Cyfraith Hywel Dda) are notoriously hard to date. The surviving manuscripts date from the 13th to the 16th centuries, however the central material of the laws was traditional and copied from manuscript to manuscript with emendations and re-ordering. By c.1300 most of the original animal material had been written and may have been over a century old, especially since the value of beaver-skin remains the same across centuries of manuscripts and all lawbooks. This means the material was essentially stagnant and therefore the date of these texts do not prove the existence of beavers in Wales at 1300 A.D.; I have included the values of live and dead animals but not the values of skins.
- Confirmations of previous charters are not included in *Rolls* texts.
- The pine marten is said to be not found in Britain in the *History of Four-Footed Beasts*.
- There are notes confirming that the wolf is gone from England in ‘The debate between the heralds of Englande and Fraunce’, *The Noble Art of Venery*, *Chronicles of England and Ireland*, *History of Four-footed Beasts* and *De Origine Moribus et Rebus Gestis Scotorum*. These are especially interesting given that the inclusion of wild boar in these texts is not commented on.
- I have not included references to park or chase (usually fallow) deer in semi-captivity, although these are sometimes hard to separate out. Poached forest deer are included. A Survey of Cornwall notes there are no naturally occurring wild red deer in the county. The difference between royal forests (places like Dartmoor) and royal parks (places like Windsor) is especially emphasised in *Patent Rolls (1909)*, *Edward III, vol.10, (1354-8)*, p.135.
- I have not included references to the position of ‘Kings Otterhunt’ as they may have had other roles.
- ‘Polcats’ and ‘Fulmards’ are mentioned together in the licenses in the *1547-63 Patent Rolls*, the ‘Act for the Preservation of Grayne’ and in the *Chronicles of England and Ireland* below. These words usually both refer to *M. putorius*. However, the word polecat is used as a generic name for any mustelid by the turn of the seventeenth century, (see *Oxford English Dictionary* ‘polecat’ sense 1b), so I tentatively identify the ‘polecats’ in these texts as martens (*M. martes*), and the ‘fulmards’ as polecats. This appears to also be R. Lovegrove’s view since he seems sure the marten was targeted by the act (*Silent Fields*, 2007, p.203). I am unsure if the ‘polcat’ in the *Noble Art of Venery* should be similarly treated, but in 1607 Topsell uses the words as we would today.
- The ‘Rotuli Hundredorum’ uses the term ‘brocces & tessones’. ‘Tesso’ is a Latin alternative for ‘taxus’, a badger. The term ‘brocces’ is often used for beavers later on so I have tentatively identified a beaver in this passage, but this is a very early date to find the confusion in nomenclature. The names and perceived characteristics of rare animals are frequently confused when an animal becomes rare or locally extinct in a process known as redelimitation (Rackham, 1986; Dent, 1974).
- There is a mention of the medicinal use of castoreum in *The Noble Art of Venery*. This is not considered a reference as it need not indicate a wild specimen rather than an imported medicine.

- There is a reference in the *Chronicles of England and Ireland* to the effect that unlike most of the wildlife which is common, the pine marten is rare and the beaver can only be found on the River Teifi.
- *The History of Four Footed Beasts* gives a long list of all the places the beaver can be found which does not include Britain, and it is described like an exotic animal so I have not included it.
- *De Origine Moribus et Rebus Gestis Scotorum* is ambiguous. It explains: *ex agris leporem & vulpem, vel ex littore et amnium ripis melem... capessunt* (p.5) (They [the locals] catch... hares and foxes from the fields and 'badgers' from the shores and deep river-banks). There was frequent medieval confusion between the badger and the beaver, for which, see *Oxford English Dictionary* sense 1b. Badgers prefer sandy ground for their setts, but will not settle anywhere wet or prone to flooding like a riverbank. For these reasons I suggest the 'melem' here are beavers not badgers.

8.1 References

8.1.1 Primary Sources

The following is a list of the editions and translations consulted for the study, ordered by date:

The Topography of Ireland - Wright, T. & Forester, T. (trans. 1863), *Giraldus Cambrensis, The Topography of Ireland*, (In parentheses Publications, revised ed. 2000, Cambridge. Digitalised proof-read edition available: http://www.yorku.ca/inpar/topography_ireland.pdf).

Rotuli Hundredorum - Public Record Office, (1812;1818) *Rotuli Hundredorum, Temp. Hen III. & Edw.I, vol. 1-2*, (by command of H.M. King George). Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing. Downloaded version much better for searching.

Medieval Welsh laws - Jenkins, D. (1986), *The Law of Hywel Dda*, (Gomer Press, Llandysul). I have included the values of live and dead animals but not the values of skins. The index of this paper translation is extensive enough to allow searching, although several laws are not included in this edition.

Charter Rolls 1226-1300 - Public Record Office, (1906;8) *Calendar of the Charter Rolls, Henry III, vol. 1-2 (1226-1257; 1257-1300)*. (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

Patent Rolls 1232-1301 A.D. - Public Record Office, (1906), *Henry III, vol.1 (1232-47), Calendar of the Patent Rolls*, (His Majesty's Stationary Office, London); Also, same series: (1908), *Henry III, vol.2, (1247-58)*; (1910), *Henry III, vol.3, (1258-66)*; (1913), *Henry III, vol.4 (1266-72)*; *Edward I, vol.1, (1281-92)*; (1895), *Edward I, vol.2 (1292-1301)*. (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

Miscellaneous Inquisitions (Chancery) - Public Record Office, (1916), *Calendar of Inquisitions Miscellaneous (Chancery), vol.1*, (His Majesty's Stationary Office, London). (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

Patent Rolls 1301-1399 A.D. - Public Record Office, (1898), *Edward I, (1301-7), Calendar of the Patent Rolls*, (His Majesty's Stationary Office, London); Also, same series: (1894), *Edward II, (1307-1313)*; (1898) *Edward II, (1313-1317)*; (1904), *Edward II, (1324-7)*; (1891), *Edward III, (1327-30)*; (1893), *Edward III, vol. 2. (1330-34)*; (1895), *Edward III, vol. 3, (1334-8)*; (1898), *Edward III, vol.4*,

(1338-40); (1900), *Edward III, vol.5, (1340-43)*; (1902), *Edward III, vol. 6 (1343-4)*; (1903), *Edward III, vol.7, (1345-8)*; (1905), *Edward III, vol. 8, (1348-50)*; (1900), *Edward III, vol.9 (1350-4)*; (1909), *Edward III, vol.10, (1354-8)*; (1912), *Edward III, vol.13, (1364-7)*; (1913), *Edward III, vol.14, (1367-70)*; (1914), *Edward III, vol.15, (1370-4)*; (1916), *Edward III, vol.16, (1374-7)*; (1902), *Richard II, vol. 4, (1388-92)*; (1905), *Richard II, vol. 5, (1391-6)*; (1909), *Richard II, vol. 6, (1396-99)*. (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

The Master of Game - Baillie-Grohman, W.M.A. and F., (1909), *The Master of Game*, (Chatto & Windus, London). (Digitalised human checked edition available: <http://www.gutenberg.org/files/43452/43452-h/43452-h.htm>).

'Moralising Poem', prologue to Amplified 'Art of Hunting' – Edited in Wright, T. & Halliwell, J.O. (1845), *Reliquiae Antiquae*, vol.1, (John Russell Smith, London). pp.149-50. (Digital edition with fair OCR available: https://archive.org/stream/reliquiaeantiqua01wriguoft/reliquiaeantiqua01wriguoft_djvu.txt, but text read in full).

Described in, Scott-Macnab, D. (2009), *The Middle-English text of the Art of Hunting by William Twiti*, (Universitätsverlag Winter Heidelberg). P.xxvi.

Boke of St Albans - Berners, J. (1596 ed.), *The Boke of St Albans*, (Digitalised human checked edition available, editor not named, Early English Books Online, http://eebo.chadwyck.com/search/fulltext?SOURCE=var_spell.cfg&ACTION=ByID&ID=D00000998477030000).

The Book of Husbandry - Skeat, W. (1882 ed.), *The Book of Husbandry, Master Fitzherbert*, (English Dialect Society, Trubner & Co, London) (Digital edition with fair OCR available: https://archive.org/stream/bookofhusbandry00fitzuoft/bookofhusbandry00fitzuoft_djvu.txt).

The Debate between the Heraldes of Englande and Fraunce - Coke, J. (1877), *Le Débat des Hérauts d'Armes (La Société des anciens textes français, Paris)* (Digital edition with fair OCR available: https://ia600607.us.archive.org/19/items/ledbatdeshra00char/ledbatdeshra00char_djvu.txt, but text read in full).

Patent Rolls 1547-1563 A.D. - Public Record Office, (1921) *Calendar of the Patent Rolls, Edward VI, vol. 1 (1547-1548)*, (His Majesty's Stationary Office, London); Also, same series: (1925), *Edward VI, vol.3, (1549-51)*; (1926), *Edward VI, vol. 4, (1550-3)*; (1937), *Philip and Mary, vol.1, (1553-4)*; (1938), (1936), *Philip and Mary, vol. 2, (1554-5)*; (1938), *Philip and Mary, vol.3, (1555-7)*; (1939), *Philip and Mary, vol.4, (1557-8)*; (1939), *Elizabeth, (1558-60)*; (1948), *Elizabeth, vol.2, (1560-3)*. (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

An Acte for the preservation of Grayne- (1819), *Statutes of the Realm, vol.4.1, (1547-1585)*, (Printed by Command of H.M. George III). 8. Eliz, c.15. (p.499) (Digital edition with fair OCR available via MEMSO 4.5, <http://sources.tannerritchie.com>, TannerRitchie Publishing).

The Noble Art of Venery - Arbor, A. (ed. 2003), *The Noble Arte of Venerie or Hunting*, (facsimile, digitalised human checked edition available of 1575 original, University of Michigan, Early English Books Online, <http://quod.lib.umich.edu/e/eebo/A14021.0001.001>)

Chronicles of England and Ireland - The Holinshed Project, (2008-13), *Chronicles of England, Scotland and Ireland, 1577 ed. vol. 1*. (Oxford University, Digitalised human checked edition available, www.cems.ox.ac.uk/holinshed/). Esp. vol. 1: 1.13; 5.4; 5.7.

A Survey of Cornwall - Gilbert, S. (2006 ed.) *The Survey of Cornwall, Richard Carew*, (Gutenberg ebook, 2003, Digitalised human checked edition, <http://www.gutenberg.org/ebooks/9878>).

History of Four-footed Beasts - Arbor, A. (2008), *The History of Four-Footed Beasts and Serpents*, (facsimile digitalised human checked edition available of 1658 original, University of Michigan, Early English Books Online, <http://quod.lib.umich.edu/e/eebo/A42668.0001.001?>).

Scotorum Historia - Sutton, D. (2010) *Scotorum Historia (1575 version)*, (Digitalised human checked edition, (<http://www.philological.bham.ac.uk/boece/>).

Description of the Western Isles of Scotland - Undiscovered Scotland, (ed. 2000-14), *A Description of the Western Isles of Scotland called Hybrides, by Sir Donald Monro*, (Digitalised human checked edition available: <http://www.undiscoveredscotland.co.uk/usebooks/monro-westernislands/>).

Chronicles of Scotland - The Holinshed Project, (2008-13), *Chronicles of England, Scotland and Ireland, 1577 ed. vol. 1*. (Digitalised human checked edition available, Oxford University, www.cems.ox.ac.uk/holinshed/). Esp. vol. 4: 1.5; 1.8. This text has been artificially separated from the Chronicles of England and Ireland for the sake of this study.

De Origine Moribus et Rebus Gestis Scotorum - Lesley, J. (1578), *De Origine Moribus & rebus gestis Scotorum*, vol.10., (facsimile, digital edition with poor OCR available ed. (1675 ed.) <http://books.google.co.uk/books?id=1ZkwAAAAYAAJ&>); Dalrymple, J. (trans. 1888), *The Historie of Scotland, Written first in Latin by the most revered and worthy Jhone Leslie, vol. 1*. (William Blackwood and Sons, Edinburgh) (Digital edition with fair OCR available: https://archive.org/stream/historiescotlan00codygoog/historiescotlan00codygoog_djvu.txt).

A Genealogical History of the Earldom of Sutherland – Gordon, R. (1813 ed.), *A Genealogical History of the Earldom of Sutherland*, (George Ramsay & Co., Edinburgh) (Digital edition with fair OCR available: https://archive.org/stream/genealogicalhist00gord/genealogicalhist00gord_djvu.txt).

Account of the Curiosities of Dumfries - Archibald, G. 'An Account of the Curiosities of Dumfries', in: Mitchell, A. and Clark, J.T. (1908), *Geographical Collections relating to Scotland made by Walter Macfarlane, vol. 3*, (Scottish History Society, Edinburgh). Pp.185-193. (Digital edition with fair OCR available: https://archive.org/stream/geographicalcol01macfgoog/geographicalcol01macfgoog_djvu.txt).

8.1.2 References

Aybes C & Yalden D (1995) Place-name evidence for the former distribution and status of Wolves and Beavers in Britain. *Mammal Review*, 25: 201-227.

Backhouse J (2002) Birds, Beasts and Initials in Lindisfarne's gospel Books 165-174, in: *St Cuthbert, His Cult and His Community to Ad. 1200*, The Boydell Press, Woodbridge.

Blanchet M (1977), *Le Castor et son Royaume*, Delachaux et Niestlé. Lausanne, 1994 ed.

Breitenmoser U (1998) Large predators in the Alps: the fall and rise of man's competitors. *Biological Conservation*, 83: 279-89.

Buttriss N (2014) Pine Marten Recovery Project. Vincent Wildlife Trust (<http://www.vwt.org.uk/docs/ezines/pine-marten-e-news-feb2014.pdf?sfvrsn=0>). [accessed March 1st 2014]

- Campbell R et al. (2012) *Distribution, Population Assessment and Activities of Beavers in Tayside*. Commissioned Report no.540, Scottish National Heritage.
- Charles-Edwards T (1989), *The Welsh Laws*, University of Wales Press, Cardiff.
- Cole M et al. (2008) Beaver. Harris S & Yalden DW (eds) *Mammals of the British Isles: A Handbook, Fourth Edition*. 72-6, The Mammal Society, Southampton.
- Coles B (2006) *Beavers in Britain's Past*. Oxbow Books and WARP, Oxford.
- Coles B (2010) The European Beaver. Sykes B & O'Connor T (eds) *Extinctions and Invasions: A Social History of British Fauna*. 104-115, The Windgather Press, Oxford.
- D'Aronco M & Cameron M (1998) *The Old English Illustrated Pharmacopia*. Rosenkilde & Bagger, Copenhagen.
- Dent A (1974) *Lost Beasts of Britain*. Harrap, London.
- Gazin-Schwartz A & Holtorf C (1999) 'As Long as Ever I've Known It...' *Archaeology and Folklore*. 2-23, Routledge, London.
- Gibson E (ed. 1695), *Britannia*, (A. Swalle, London).
- Halley D, Rosell E & Saveljev A (2012) Population and Distribution of Eurasian Beaver (*Castor fiber*). *Baltic Forestry*, 18: 168-175.
- Harting J (1880) *British animals extinct within historic times: with some account of British Wild Cattle*, Ballantyne and Hanson, Edinburgh.
- Jenkins D (1986) *The Law of Hywel Dda*, Gomer Press, Llandysul.
- Johnson C (1925) The Oldest Version of the Customs of Newcastle-upon-Tyne. *Archaeological Aeliana*, 4th series 1: 169-178.
- Kitchener A & Conroy J (1997) The history of the Eurasian Beaver *Castor fiber* in Scotland. *Mammal Review*, 27: 95-108.
- Lovegrove R (2007) *Silent Fields*. Oxford University Press.
- Morton, D. et al. (2011) *Final Report for LCM2007 – the new UK Land Cover Map*, (Countryside Survey, Centre for Ecology and Hydrology, Natural Environment Research Council)
- Neill P (1819) Proofs that the Beaver was formerly a native of Scotland, including an account of some fossil remains of that animal found in Perthshire and Berwickshire. *The Edinburgh Philosophical Journal*, 1: 177-187.
- Neill P (1821) Account of some fossil remains of the beaver, (*Castor Fiber L.*) found in Perthshire and Berwickshire, proving that the animal was formerly a native of Scotland. *The Memoirs of the Wernerian Natural History Society*, 3: 207-219.
- Rackham O (1986) *The History of the Countryside*. Weidenfeld & Nicolson, London, 1995 ed.
- Raye L (2013). Lions in Insular British Artwork, 650-1000 A.D. *Journal for Late Antique Religion and Culture*, 7: 72-89.
- Ritchie J (1920) *The Influence of Man on Animal Life in Scotland: A Study in Faunal Evolution*.

Cambridge University Press.

Sheppard T (1903) Note on Beavers in East Yorkshire. *The Naturalist*, 1903 ed: 109-10.

Taylor A (2012) The Assizes of David I, King of Scots, 1124-53. *Scottish Historical Review*, 91: 197-238.

Veale E (2003) *The English Fur Trade*. London Record Society.

Walls S & Morris B (2013) *Results of a Revised Topographic Study*. Southwest Archaeology, Commissioned by Devon Wildlife Trust). *Site name omitted for privacy*.

Wilson C (1858) Notes on the Prior Existence of the Castor Fiber in Scotland, with its Ancient and Present Distribution in Europe, and on the use of Castoreum. *The Edinburgh new Philosophical Journal*, new series 8: 1-40.

Yalden D (1999) *The History of British Mammals*. Poyser Natural History, London.

Yalden D (2007) Beavers in Britain's Past. *Mammal Review*, 37: 80.

Yalden D & Albarella U (2009) *The History of British Birds*. Oxford University Press.

Zeiler J (2007) Beavers in Britain's Past. *The Antiquaries Journal*, 87: 146.